AN ANALYSIS OF A MULTIDIMENSIONAL APPROACH TO JOB PERFORMANCE MEASUREMENT

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Charles Lamar Anderson

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AN ANALYSIS OF A MULTIDIMENSIONAL APPROACH

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Approved:

W. W. Ronan, Chairman

Randall M. Chambers

Gerald Day

This thesis is dedicated to the Hardens

Barbara, Kimberly, and Rick

who provided the encouragement to undertake

this study. It is also dedicated to the Lewises

Rudene, Jay, and Seth

who provided the encouragement to complete it.

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ABSTRACT

Two methods of job analysis, the Critical Incident Technique (CIT) and the Position Analysis Questionnaire (PAQ), were used to identify firefighter job performance dimensions. Following identification of these dimensions, twenty-five performance measurement instruments were constructed and administered to 598 firefighters in the Atlanta Metropolitan area. A cross-validation factor analysis was then performed on the data which were collected. An analysis of the factor structure between the two groups indicated that the factor structures were quite similar. An overall factor analysis was then performed using a principal factor with iteration analysis with a varimax rotation. Nine factors of firefighter job performance were identified. In general, it would appear that the measurement of job performance can be approached from the psychometric point-of-view and measuring instruments of demonstrable theoretical and practical utility constructed to evaluate job performance.

CHAPTER I

INTRODUCTION

The criterion problem has been evident in industrial psychology for many years. Ronan and Prien (1966) in their publication, Toward a Criterion Theory, quoted a comment made by Viteles in the mid-1920's, "... it requires only a brief survey of the literature to show that in spite of the recognized importance of reliable standards and/or recognized precautions in the selection of such standards, the criteria in industrial investigations have on the whole been very unsatisfactory." In the Annual Review of Psychology, almost four decades later, Dudek (1963) noted that, "criterion problems, as usual, received a great deal of attention --- and some action."

The concept of the criterion in much applied research has implied the possibility of identifying a single ultimate measure against which predictors should be correlated. It is here argued that the criterion investigation has been underemphasized with the result that complexities of predicting the many facets of job success have been ignored in favor of overly simplified studies designed to relate predictors to single measures of job success. "Applied psychologists should give more emphasis to construct validation and make an effort to learn more about the meaning of test scores and other predictors in terms of multiple dimensions of behavior" (Dunnette, 1963, p. 251).

It is obvious from the literature that the "criterion problem", or how performance is to be evaluated, appears to be an area of

importance to industrial psychologists and others involved in psychological research and practice. The general point can be made that performance per se has not been extensively studied although its complexity has been implicitly recognized by use of the word "dimensions", see Ghiselli and Brown (1951), Thorndike (1949), Krug (1961), Nagle (1953), Tiffen and McCormick (1965), and Dunnette (1963). Otis (1953) identified the researcher and the practitioner as the culprits who have historically selected the "most noticeable" criterion rather than to concentrate on the development of the "most appropriate" criterion or criteria. Thus, the lack of attention devoted to criteria development probably explains why the prediction of behavior has not improved over the years.

Background of Present Work

In 1964, the Federal Government passed into law the Civil Rights Act. This legislation made it illegal to discriminate when hiring or promoting on the basis of race, color, sex, or religious beliefs. In 1972, the Equal Employment Opportunity Commission was established as the legal agency to administer and enforce non-discriminatory hiring and promotion. Now many governmental agencies, as well as industrial concerns, have found themselves faced with developing "affirmative action" programs designed to demonstrate the validity of their current selection procedures and screening devices. In effect, the "criterion problem" has become critical in both the practical and research senses.

CHAPTER II

HISTORICAL REVIEW

In relation to the "criterion problem", basically three approaches have been used in psychological research on performance evaluation. These include ratings, a combination of ratings and some more objective performance measures, and factor analyses of intercorrelation matrices which describe performance where both ratings and objective indices are contained in the evaluation of performance. The following review represents proportionally the extent to which these various approaches to job performance evaluation have appeared in the literature.

Ratings

The predominant method used in performance evaluation has been, and continues to be, a subjective rating of an individual's performance by some specified observer. The form of this subjective rating is varied from a Likert-type format to a forced choice, to a checklist or some modification of these. This approach often implies that job performance is unidimensional. This reduction of performance measurement to a single measure, e.g. subjective rating, seems to oversimplify what constitutes effective job performance. There is a considerable body of research showing that job performance is multidimensional, see Rush (1953), Turner (1960), Ronan (1963a & 1963b), Prien (1965), Dunnette (1963), Ghiselli and Haire (1960).

When subjective ratings are used as a method of job performance

measurement, some important implications must be considered. First, are the results obtained using this measurement device replicable? Ronan and Schwartz (1974) point out that the basic rating paradigm involves two or more observers who, independently and usually concurrently, record their assessment on the performance of persons engaged in the same activity. That is, the evaluations reported by each observer must be in no way dependent upon the evaluations of the other observer. Rater independence is extremely difficult to obtain because raters tend to discuss the ratees which at least to some extent affects the product of these rating values. As Ronan and Schwartz (1974) concluded from their review of the literature, the results obtained from ratings which are not independent usually indicate an interrater correlation on the order of 0.60, whereas independent assessments yield much lower correlations.

Lifson (1953) demonstrated that when ratings are applied to job performance, the results should be interpreted with caution. Time study personnel were trained to rate "work pace" as compared to "normal" for five different persons on four different jobs. The subjects were college students who had had previous industrial experience. The subjects' "work pace" was stabilized, as much as possible, through extensive practice which was paced by a metronome. These research findings indicated that ratings involved considerable error:

(1) Certain raters consistently rate higher.

(2) Certain subjects were rated higher.

(3) Certain jobs were rated more reliably.

(4) The raters tended toward a norm.

(5) Interactions during rating sessions were of importance.

(6) An analysis of variance conducted on the research data indicated that about one third of the variance in the ratings resulted from interrater differences.

Therefore, the Lifson study may be interpreted as an indication that performance measurement cannot be reliably assessed through the use of subjective evaluations because even specifically trained raters could not agree among themselves as to what they were actually observing when people were at work.

Ryans and Fredericksen (1951) cited a study in which raters were required to judge the taper of "metal objects" which were supposedly constructed to specification. They reported that the reliabilities which were obtained subjectively by the "eyeball technique" ranged from 0.11 to 0.55. When a taper gauge was used by the raters in their judging, the reliability was raised to a range of 0.93 to 0.94. This finding led them to make the following statement, "It is possible to study reliability of performance (as distinguished from judging performance) only where the reliability of judging performance has been shown to be adequate." This is a valid requirement which should be met by any researcher who makes use of a subjective evaluation as a criterion.

Gaylord et.al.(1951) found correlations of 0.48 to 0.55 between composite production records and ratings of file clerk performance and 0.24 to 0.46 between job elements and ratings. But it must be pointed out that the raters in this study had access to production records which would tend to inflate the resulting coefficients. However, their findings still led them to conclude that the correlation between two criteria should greatly exceed the level usually obtained in most

validation studies between a predictor and a criterion.

Springer (1953) conducted a study in which she compared ratings using a graphic eight-item scale which was administered to 100 co-workers. She found the inter-rater reliabilities among the peer ratings to range from 0.34 to 0.48 and the inter-rater reliabilities among the supervisors to range from 0.56 to 0.71. The correlations found between supervisors and peers, however, ranged from 0.15 to 0.39. The ratings of the two groups cannot be considered equivalent, but which of the two ratings should be used? It should be noted that in this study the ratings were used for promotional purposes. This can lead to a "halo effect" or "leniency error" when peer ratings are used for promotion or merit pay increases. It has been shown by Hollander (1954, 1956), Hollander and Webb (1955), and Wherry and Fryer (1949) that the postulated contaminating effect of friendship might be ruled out. In fact, their evidence suggested that friendship is possibly beneficial in terms of the opportunity to observe. Therefore, the contention is that the reliability of peer ratings in pure research may be higher than supervisory ratings. However, when peer ratings are used in an applied setting (e.g., promotion, wage and salary increases, etc.), then the probability of contaminated results is greatly enhanced since there is a tendency to overrate friends and under-rate those who are disliked. Obversely, Ronan (1970) showed that in one plant peers intentionally under-rated the better personnel, in order to prevent losing them to the corporate headquarters.

Kipnis (1960) has presented data to show that subjective performance ratings are distorted by supervisor-subordinate relationships

and the context in which they occur. The following represent examples of the "external factors" which he identified:

(1) Propinquity in the sheer physical sense.

(2) Social setting whether it be cooperative or punitive.

(3) Whether or not criticism is encouraged.

(4) Subordinate who does well what the rater emphasizes.

(5) Halo by a subordinate who does well what the rater emphasizes.

(6) Personal stake by the rater in the rating or its use.

Relationships Between Ratings and Other Performance Measures

The literature dealing with the relationships between ratings and other performance measures is somewhat limited. One of the better research efforts was conducted by Borg and Hamilton (1956) who investigated the performance of 89 instructors at an Air Force basic training school. Ratings were obtained from students (subordinate), supervisors, peers, and the instructors themselves (self). The performance criteria employed in this study were twelve problems which were taught in training (e.g., escaping from prison camps) and were solved by six man teams. All instructors were rotated among the groups periodically. There was a noticeable lack of independence among some of the raters which explains why the findings indicated that supervisory, peer and self ratings correlated 0.71. The student ratings, however, correlated 0.17 with the other three ratings. Futhermore, the correlations between the four subjective ratings and the performance tests were: 1) students versus tests (0.19); 2) peers versus tests (0.11); 3) supervisors versus tests (0.13); and 4) self versus tests (0.01). In other words, the subjective ratings were insignificantly related to these objective

performance measures.

Peters and Campbell (1955) investigated the relationship between self and supervisory ratings of proficiency as compared to the diagnostic proficiency test score of Air Force mechanics. The authors concluded that the relationships between the subjective ratings and the diagnostic proficiency test were not high enough to warrant a substitution. Their decision was justified in light of their findings that the pre-test ratings (self and supervisory) correlated 0.33 and 0.35, respectively, with the proficiency test.

Sprecher (1959) conducted a study of the "creativity" of 107 engineers. The methodology consisted of testing the engineers over three simulated problems, tabulating each engineer's patent disclosures, and collecting peer and supervisory ratings. The correlation between the peer and supervisory ratings was found to be 0.64. The supervisory ratings correlated with the three simulated problems and the patent disclosures 0.11, 0.14, 0.29, and 0.32, respectively. The peer ratings correlated, respectively, with the same variables at 0.07, 0.06, 0.26, and 0.27. Several important points should be noted. The first was that there were strong indications, due to the high correlation between peer and supervisory ratings, of a lack of independence among the raters. Secondly, the high correlations between the subjective ratings and the more objective indicators of performance (patent disclosures) were also contaminated by the rater's knowledge of each engineer's patent disclosures. Even with these possible sources of contamination, the correlations found were still so low as to be of little use.

In similar studies by Morrison, et.al. (1962) dealing with petro-

leum research engineers and Tucker, Cline, and Schmitt (1967) dealing with pharmaceutical scientists, both research groups reported similar findings. In other words, the intercorrelations among the peer and supervisory evaluations were low, many of them negative, and evaluations of creativity did not agree among supervisors and peers.

Maslow, Campbell, Anastasi, Guion, et.al. (1972) conducted a study for Educational Testing Service in which they investigated sources of bias in the prediction of job performance among government employees. They stated that they believed job performance to be multidimensional and, accordingly, developed three types of performance measures including specifically constructed rating scales, defined and anchored by behavioral descriptions of job performance; a job knowledge test; and a work sample. The correlations among the three different groups of measures under investigation ranged from 0.47 to 0.55 between the job knowledge test and the work sample; 0.28 to 0.42 between ratings and the job knowledge test; 0.14 and 0.37 between ratings and the work sample. The low correlation between the ratings and the work sample found in this study further documents the inappropriateness of subjective ratings. The work sample versus the job knowledge test had a moderate correlation, however, which would seem a more appropriate substitution. On the other hand, it must be acknowledged that the subjective ratings may have contributed some unique information not given by the job knowledge test in the prediction of the work sample.

Based on this review of the literature which has dealt with the relation between subjective ratings and objective indicators of performance, it can be stated that repeated investigations have been conducted

using a great variety of objective behavioral indices. The results have been relatively consistent with the reported correlations between subjective evaluations and objective indices rarely exceeding 0.40. It also has been pointed out that when this level is exceeded, it is usually due to contamination introduced by access to objective scores either before or during the rating process to persons who are evaluating performance. If independence between raters is maintained, then the correlations which are found are even lower. Therefore, raters must either be evaluating performance on some basis other than actual performance behaviors or raters may not be behaving consistently in the presence of different observers.

Factor Analysis of Performance Indices

Jaspen (1949) and Palmer and McCormick (1961) used exploratory factor analysis to define the dimensions of job functions in order to determine the meaningful factors in "lower level" jobs in a sample of 250 steel mill jobs. The former study found six factors and the latter study found four factors indicating that even relatively simple jobs have several independent common-factor dimensions with the possibility of finding even more dimensions with a more rigorous investigation. These studies indicate that job performance has a complexity which requires coverage by a multi-demensional measurement technique.

Another use of factor analysis has been in analyzing the relationship between ratings and objective indices of performance. This method has made use of factor analyses of intercorrelation matrices which describe performance where both ratings and objective indices of such performance were contained in the evaluation of performance. Rush (1953) was one of

the first to experiment with this approach. He used as subjects, college graduates who had completed a sales training program and who had been working in the field for some time. The criteria, which were used, included percent of assigned sales quota achieved, average number of sales, average monthly volume (all of which were corrected by a base sales figure), grades and ratings in a technical school, and subjective ratings by sales managers on a scale of one to nine. The intercorrelation matrix among these variables was then factor analyzed and four factors were extracted:

Factor I - Objective achievement with loadings on the described sales indices.

Factor II - Learning aptitude with loadings on grades and ratings (training of technical knowledge and learning).

Factor III - A general sales manager rating factor.

Factor IV - A sales technique and achievement factor on which weak, scattered loadings of achievement and ratings were located.

The most interesting feature of this study was that, essentially, objective performance composed one factor while manager's ratings of job performance composed another independent factor.

Turner (1960) reports another factor analysis study which is illustrative of the lack of relationship between ratings and objective indices of performance. His investigation was concerned with foreman performance in two different plants. Two intercorrelation matrices composed of eleven objective measures and a nine-trait rating of job performance were then factor analyzed. The factor analysis for both plants yielded three similar factors which covered rated performance (probably "halo effect" and reputation), an employee relations factor,

and finally a bi-polar factor covering scrap and suggestions which indicated that good performance on one was accompanied by poor performance on the other. The other two factors, which were found, were much more poorly defined and were different in the two plants.

Ronan (1963a) studied the performance of skilled tradesmen in a steel mill. He used three ratings and eight objective performance measures. A factor analysis of these eleven measures yielded four factors. The first of these was a promotion-supervisory rating factor, another was an apprentice school rating-grade factor, with the objective performance indicators independent of the other factors. Ronan (1963b) conducted a similar study in which he evaluated all workers in two different plants using seven performance measures and a subjective supervisory rating. Once again he found four factors in separate factor analyses of the two plant intercorrelation matrices. He reported that in both cases the loadings for the supervisory ratings were somewhat broadly distributed across the factors. In the individual plant factor analyses, however, supervisory ratings were highly related to absence and disciplinary actions in one plant and to lost time accidents in the other.

The Ronan (1963a, 1963b) findings emphasize an important point which was originally reported by Heron (1954). He had supervisors rate their subordinates as to how much "concern" they caused the supervisor. In many other studies of performance, such as Seashore, et.al. (1960), ratings have been found to correlate with absence to a higher level than with any other variable. These findings indicate that this aspect of the supervisor-subordinate relationship can be rated adequately as, indeed, it seems to be the basis for ratings. Therefore, supervisors seem able to

subjectively evaluate "concern" caused by subordinates, but should not be asked to subjectively evaluate total performance. In summation, the factor analytic studies, when considered as a whole, tend to indicate that performance and subjective rating of that performance by an observer are independent of each other. However, the strength of any conclusion based on this indication of independence obtained through factor analysis is questionable due to the method variance problem discussed by Jackson (1969).

A more useful approach to the study of job performance was that of Flanagan (1949, 1954a, 1954b). By use of his critical incident technique (CIT), he isolated and defined "job elements." The CIT, or Flanagan studies, represents a systematic attempt to study job performance in terms of its complexity and situationally specific behavioral components. This technique is dependent upon observation and subjective reporting of some behavioral incident. It is therefore subject to question as to the comprehensiveness of data collected using this methodology. An additional weakness is that it does not investigate what job performance could or should be. Even with these limitations, the CIT represents one of the more useful and efficient methods of job analysis.

While some people have been attempting to isolate job dimensions, others have been trying to stabilize the terminology used in this type of research. Campbell, Dunnette, Lawler, and Weick (1970) distinguished among the concepts of behavior, performance, and effectiveness as three outcomes of organizational roles. Behavior is simply what people do in the course of working (e.g., transporting and placing ladders, hooking hoses to hydrants, etc.). Performance is behavior that has been evaluated

(i.e., measured) in terms of its contribution to the goals of the organization. Lastly, effectiveness refers to some summary index of organizational outcomes for which an individual is at least partially responsible such as amount of property lost, time to bring fire under control, etc.. Campbell and Hellervik (1973) have argued that psychologists should be trying to measure and predict the major dimensions of performance rather than effectiveness, since a measure of effectiveness is one or more steps removed from what the individual actually does. Therefore, they made use of a variant of the critical incident metholology to develop behaviorally-based rating scales through extensive participation by the people who were to use them resulting in scales which were in the language of the organization. This method using behaviorally-based statements taken from critical incident methodology yielded less method variance, less halo error, and less leniency error. However, this rating method deserves more investigation before it can be used practically and accepted.

In summary, the research evidence seems to indicate that the use of ratings to evaluate job performance has not been justified. Further, job performance is highly complex and has not been, but must be, studied in and of itself before levels of performance prediction can be improved.

This study was designed to explore the relationships between varied job performance measurements in order to determine their characteristics and interrelationships. More specifically, the objectives of this study were:

(1) To identify the dimensions of firefighter job performance.

(2) To develop at least one performance measure for every job dimension identified by the job analyses which were performed.

(3) To determine if job performance can be measured as a unitary characteristic or if measures of job dimensions are independent of each other.

(4) To demonstrate that subjective evaluations of job performance by two independent sets of evaluators do not agree.

(5) To demonstrate that subjective evaluations of job performance do not agree with objective measures of job performance.

(6) To demonstrate the multidimensionality of job performance.

(7) To provide a rational multidimensional research strategy which can be used to accomplish both job analyses and performance evaluations.

In order to accomplish these objectives, the research was conducted on the performance indices of firefighters in the metropolitan Atlanta area.

CHAPTER III

JOB ANALYSES

The firefighter's job represents one of the most demanding and important classifications listed by local county governments. This classification is concerned with public safety and involves the protection of life and the prevention of property losses to residents. Despite the importance of this classification, a review of the literature by this author indicated that very little research had been completed on the job of firefighter. In fact, only one study (Murdy & Norton, 1972) was located that could be considered a relevant research study. The importance of the potential economic and human losses, coupled with the lack of related research, led to the selection of the firefighters as the job classification to be researched. Since so little job information was available, this research effort was begun with a job analysis program using the Position Analysis Questionnaire (PAQ) and the Critical Incident Technique (CIT) as recommended by Ronan and Prien (1971). The research was conducted on firefighters from five local jurisdictional fire services within the metropolitan Atlanta area to define and describe the job dimensions of firefighters as thoroughly as possible, as a first step in bettering the prediction of job performance.

Position Analysis Questionnaire

The first job analysis method applied to the firefighter classification was the Position Analysis Questionnaire (PAQ). This method

was chosen because it established the level of various physical and mental components required for the job under investigation. The PAQ, developed by McCormick, Jeanneret, and Mecham (1969), consists of 189 job elements grouped into six major sections: 1) information input, 2) mediation processes, 3) work output, 4) interpersonal activities, 5) work situation and job context, and 6) miscellaneous aspects. This approach to the job analysis of the firefighter population was predicated on essentially three assumptions:

(1) A given kind of work activity or a given type of work situation involved generally the same "job requirements" in whatever job the activity or situation occurs.

(2) Job activities and job situations could be characterized in terms of relevant "units" (job elements) that can be reliably identified or rated as they exist in jobs.

(3) There is order or structure in the domain of human work and the use of essentially work-oriented job elements used in describing work makes it possible to determine, statistically, the nature of that structure.

The basic paradigm of the PAQ involves having persons who are familiar with the job (e.g., supervisors, tenured job incumbents, etc.) evaluate the job in question as it relates to the 189 elements of the PAQ, usually on a six-point Likert-type scale ranging from "does not apply" to "strongly applies". In other words, the "evaluators" indicate the level of a particular dimension required for the job under scrutiny. It should be noted that the PAQ is a factor analytic job analysis technique which has been under development since 1961.

The PAQ was administered to three officers in each jurisdiction who had been firefighters and were concurrently responsible for the supervision of firefighters. Following the administration of this instrument, the data were forwarded for analysis to PAQ Services, Logan, Utah. The results of the PAQ job analysis gave an estimation of the various human characteristics involved in the firefighter's job and how the job of firefighter compares with over 500 other job classifications. The 32 dimensions obtained with the PAQ describe both the mental and physical characteristics of the firefighter's job and indicate the level of a particular dimension which is required for the job. It should be noted that an independent PAQ job analysis was conducted for each of the five jurisdictions. (See Appendix I.) Also by having three officers within each jurisdiction fill out the Position Analysis Questionnaire, interrater reliabilities were obtained which ranged from 0.80 to 0.89. The results of these analyses were not comprehensive enough for the construction of job performance criteria, since actual job behaviors were not obtained, but it did supply some helpful indications as to the levels of various physical and mental components required on the job.

Critical Incident Technique

In order to describe the actual job behaviors, a second job analysis was performed with the assistance of two other researchers using the Critical Incident Technique (CIT). In order to complete this analysis within a practical time limitation, it was necessary to select a random sample of job incumbents from which to collect the "critical incidents."

A sample size of approximately thirty-five firefighters was

selected randomly in four of the participating jurisdictions and a sample size of approximately one hundred was selected in the other jurisdiction. The firefighters chosen from the total population for this analysis were then asked to write a minimum of two job-related incidents, one of which dealt with an effective firefighter and the other with an ineffective firefighter. In other words, they were asked to write a short narrative describing a situation in which they observed another firefighter doing an effective job. They were also asked to write another short narrative in which they described a situation involving another firefighter doing an ineffective job. An independent CIT analysis was not attempted for each of the jurisdictions because of the limited sample size within some jurisdictions and because the PAQ analysis indicated that the similarity of the firefighter's job across jurisdictions did not warrant separate analyses. Therefore, the data collection on this part of the project netted approximately 600 behavioral incidents upon which categorization was conducted to determine the relevant firefighter dimension.

The categorization of the behavioral incidents was accomplished in the following manner. This researcher and two individuals (T. L. Talbert and W. W. Ronan) performed independent categorizations of the behavioral incidents. This involved having the incidents typed on 3x5 inch index cards. The cards were then individually read and subjectively sorted into stacks having similar content. The initial sort thus completed, the stacks of cards having similar content were tentatively named (given category titles) and marked with identification numbers (on back of index card). Each individual then went through the categorization procedure approximately three to four times, checking after each sort to

determine if the placement of a particular behavioral incident into a particular category was stable. Following independent categorization, all three catergorizations were compared (number of categories ranged from 14 to 17). The three researchers decided unanimously that fifteen categories adequately covered the job dimensions of the firefighter classification (See Table 1).

In Appendix II, the reader will find examples of the types of behavioral incidents of which the fifteen performance dimensions were composed. The fifteen critical incident category titles were further broken down into four behavioral classifications of firefighter job dimensions. (See Table 2.)

The job analysis results were then presented at a December, 1973, seminar composed of the fire chiefs and training officers from the five participating jurisdictions. The fifteen officers present at this meeting were asked to review the job analysis findings and comment, based on their experience, as to whether these fifteen dimensions, which had been reported, adequately covered the firefighter classification. The consensus among these officers was that the CIT dimensions adequately covered the job of firefighter, thus accomplishing the first objective of this study. A comparable job analysis independently conducted in the Fort Worth, Texas, fire service by Murdy and Norton (1972) op. cit identified a similar number of dimensions whose contents were highly congruent with those found in this study. (See Appendix III.)

Table 1. Critical Incident Category Titles for Firefighters

Incident Frequency Counts		Category Titles
(73)	A.	Specialized job knowledge.
(45)	B.	Interest in learning.
(29)	C.	Helping others learn.
(54)	D.	Relationship with peers.
(17)	E.	Relationship with public.
(51)	F.	Willingness and eagerness to do their part of the work at the station.
(57)	G.	Willingness and eagerness to do their part of the work at the fire.
(8)	H.	Respect for property and equipment.
(37)	I.	Professionalism.
(65)	J.	Remains calm in personally demanding situations.
(16)	K.	Ability to perform physically demanding tasks.
(17)	L.	Ability to follow orders.
(25)	M.	Responsibility for the safety of others.
(67)	N.	Ability to make correct decisions.
(40)	O.	Ability to work effectively in a hazardous, unpleasant environment.

Table 2. Behavioral Classification of Firefighter Job Dimensions

I. Job Knowledge

A. Specialized job knowledge.

B. Interest in learning.

C. Helping others learn.

II. Interpersonal Relations

D. Relationship with peers.

E. Relationship with public.

III. Approach to Work

F. Willingness and eagerness to do their part of the work at the station.

G. Willingness and eagerness to do their part of the work at the fire.

H. Respect for property and equipment.

I. Professionalism.

IV. Job Performance

J. Remains calm in personally demanding situations.

K. Ability to perform physically demanding tasks.

L. Ability to follow orders.

M. Responsibility for the safety of others.

N. Ability to make correct decisions.

O. Ability to work effectively in a hazardous, unpleasant environment.

CHAPTER IV

CONSTRUCTION OF PERFORMANCE MEASUREMENT INSTRUMENTS

The second objective of this study was to develop at least one performance measure for every job dimension identified by the job analyses which were performed. Therefore, the next phase of this research project consisted of the performance criteria development. During this phase, the behaviorally-based performance evaluation checklist, the job knowledge test, the objective performance tests, and the tab tests were developed in conjunction with fifteen training officers from the five participating fire services. The methodology used in the development of these various measurement instruments will be discussed in this chapter.

Behaviorally-Based Performance Evaluation Checklist

A preliminary 152-item checklist was constructed using behavioral statements obtained from the critical incident data. The basic construction of the preliminary checklist was begun using from eight to fourteen statements, taken from the CIT data, for each of the fifteen dimensions. The resultant preliminary checklist was then administered to a random sample of 82 firefighters from the participating jurisdictions. These men were asked to rate the different individuals with whom they worked on a six-point Likert-type format ranging from "strongly applies to the individual being rated" to "strongly does not apply to the individual being rated". The preliminary 152-item performance evaluation checklist was then split in half and factor analyzed using a weighted principal

components analysis with a direct oblimin rotation. (The results of these analyses will not be presented because they are not germane to this thesis.) From these analyses, the final 75-item checklist was constructed using five behaviorally-based statements with factor loadings above .45 for each of the fifteen dimensions. (See Appendix IV.) The behaviorally-based performance evaluation checklist was then converted to a dichotomous (yes, no) format in order to maximize the resultant correlations. However, since some of the statements were found to be situationally-specific in the pilot experiment, it was decided to allow a "don't know" response when subjects could not say that a particular statement really applied or did not apply to a specific individual because of a lack of experience with that individual. This instrument was constructed partly to determine if job performance could be measured as a unitary characteristic as per the third objective of this study.

Job Knowledge Test

The construction of the firefighter job knowledge test involved the assimilation of multiple-choice training and promotional test instruments from the participating training departments. This complilation yielded questions which covered the job knowledge aspects of many of the relevant job dimensions found in the critical incident analysis of the firefighter classification. These various instruments which dealt with fire prevention, salvage and overhaul, extinquishment, rescue, and ventilation were then analyzed to eliminate confusion over jurisdictional administration of policies and procedures. The result of this analysis was a 120-item multiple-choice job knowledge test which was then submitted to fifteen training officers in the five participating jurisdictions for

review. This review included clarity of the statement of questions as well as their indication of the correct answer from among the possible alternate answers. Following completion of their review, these preliminary job knowledge tests were then returned by the training officers to this researcher who selected fifty of the multiple-choice items upon which there was consensus as to question clarity and the correct answer. The final 50-item job knowledge test was then presented at a February, 1974, workshop to all training personnel who agreed on its correctness and appropriateness. (See Appendix V.)

Objective Performance Tests

The development of practical performance tests was also accomplished in conjunction with fifteen training officers in the five jurisdictions. Beginning with consideration of the fifteen relevant job dimensions which had been identified in the critical incident job analysis, and then relying on the levels of various mental and physical characteristics obtained through use of the Position Analysis Questionnaire, as many practical tests as possible were designed to evaluate the firefighter dimensions.

These tests were developed to serve as work samples based on the kinds of tasks which a firefighter is called upon to perform in his regular work situation. In other words, objective performance criteria were constructed which were job-related. The final battery of performance criteria consisted of the following work samples:

(1) Knots and ropes.

(2) One-man hose lay.

(3) Spotting and hook-up of soft-suction supply hose.

(4) One-man ladder handling.

(5) Hand traverse across a 24-foot ladder.

(6) Handling of Scott-air paks.

(7) Ladder climb with weight.

(8) Ladder descent with weight.

(9) Improper and dangerous equipment storage.

(10) Hose and nozzle (equipment) inspection.

For a complete description of the various practical tests listed above, the reader should refer to Appendix VI. Of interest in this research were the techniques used to accomplish the various tasks, number of errors, and elapsed times during the administration of these performance tests.

Tab Tests

The next phase of performance criteria development dealt with the construction of pencil-and-paper performance tests known as tab tests. The original work with tab tests was conducted by Damrin in the late 1940's at the University of Illinois. Tab test have been used mostly in studies of creativity and problem-solving. Ronan and Sivy (1952) made use of tab tests in a study of emergency procedures encountered in multi-engine aircraft. They attempted to determine the feasibility of using tab tests in performance assessment as opposed to using aircraft simulators. They obtained correlations between these two methods which ranged as high as 0.98. Therefore, the ethical considerations, as well as the economic and time limitations, led to the selection of the tab test format for use in this research project, as opposed to construction of actual fire simulations, to assess the firefighter's ability to integrate situational input in solving problems.

These tests were also built in conjunction with the jurisdictional training officers who provided the technical input necessary for construction of these instruments. After consultation with the training officers, it was decided to use a hypothetical fire situation involving a fire in a nine-story building surrounded by an L-shaped eleven-story building. Drawings of this building were then layed out such that certain situational constraints were introduced which precluded using certain techniques and/or strategies. The reader should refer to Appendix VII for additional information concerning the various views of the building and the accompanying narrative which explains why things are the way they are in the drawings. Tab tests were then developed on the topics of rescue operations, ventilation operations, fire suppression operations, and salvage and overhaul operations. For instance, under the heading of firefighter rescue knowledge, there were three tab tests constructed. (See Appendix VIII.)

The first tab test dealt with possible rescue techniques in which the job incumbent was given twelve possible techniques which could be used to rescue thirteen victims trapped in the involved nine-story building. At the far right side of the test page corresponding to the possible rescue techniques were twelve silver boxes underneath which either a "yes" or "no" was printed. In other words, there were eleven "no's" and one "yes" which had been covered with silver ink. The firefighter was then asked to determine, from among the twelve alternatives, the one rescue technique which would work in this particular situation. To do this, the firefighter erased the silver ink to determine if he had located the correct "yes" item. The purpose of this test was to ascertain

not only a firefighter's job knowledge, but also to determine how well the firefighter could integrate written and visual input in solving problems. The objective was to make as few erasures as possible in order to identify the proper rescue technique. Therefore, this testing procedure served a two-fold function in that it simultaneously served as a method of evaluating firefighter performance and also served as a training session in that the firefighter knew when he had located the proper rescue technique. The immediate feedback, therefore, created a learning situation.

The second tab test under the heading of rescue knowledge dealt with possible methods of providing protection from exposure to the victims being rescued. The job incumbent was given thirteen possible methods of protecting the victims from fire exposure and was then asked to determine, from among the thirteen alternatives, the appropriate method of providing exposure protection to the victims being rescued. The final tab test dealing with firefighter rescue knowledge was concerned with the firefighter's ability to select from among thirty-nine available pieces of equipment, the appropriate ten pieces of equipment which were determined, by the training officers, to be the minimum amount of equipment necessary to accomplish this particular rescue in this particular situation.

The next area of concern dealt with firefighter ventilation knowledge under which four subtests were constructed. (See Appendix IX.) The first involved the determination of the proper accesses to the roof of the involved nine-story building. There were three methods of access which were appropriate in this particular fire and were to be located from among thirteen alternate accesses. The next subtest dealt with the

order of ventilation. The firefighters were required to indicate which of the items on the roof of the nine-story building were to be vented, as well as the order or sequence which was to be used in accomplishing the ventilation based on the information obtained from the narrative and the drawings. The final subtest involved the methods of ventilation. The firefighters were asked to describe in a couple of sentences how to vent each of the four items designated for ventilation. Ventilation knowledge testing was then concluded with the determination of the minimum amount of equipment necessary to accomplish the required ventilation from among a listing of available equipment.

The fire suppression knowledge section consisted of one tab-test. (See Appendix X.) By referring to the descriptive narrative, the set of drawings of the fire scene, and additional information as to types and locations of attack lines which were available at the fire scene, the firefighters were asked to determine which statements about actions to be taken were correct. The statements dealt with what to do and when to do it. The salvage and overhaul knowledge section also consisted of one tab-test. (See Appendix XI.) By referring to the descriptive narrative, the set of drawings of the fire scene, and the additional information which was provided, the firefighters were asked to determine which statements about actions to be taken were correct. The statements dealt with what should be done and what should not be done during salvage and overhaul operations in the involved nine-story building.

The last two tab-tests dealt with problem-solving situations involving a malfunctioning MSA air pak and a pumper operation malfunction at a fire scene. (See Appendix XII.) The firefighters were given

descriptions of the situations and conditions surrounding the hypothetical problems. Their knowledge of what to do to correct the problems, as well as their ability to assess the probable causes, were then determined.

Cardio-Pulmonary Resuscitation (CPR)

In conjunction with the assisting training officers a decision was reached that a test, developed and administered by the Georgia Heart Association, would serve to evaluate a firefighter's first-aid knowledge. This test dealt with cardio-pulmonary resuscitation. (See Appendix XIII.) This highly skilled life-saving technique had been taught by the training departments of all of the involved jurisdictions. Therefore, a working knowledge of this technique was considered a job requirement. CPR further represented one of the most difficult parts of a firefighter's first-aid training and, thus, provided the necessary differentiation as to the level of first-aid knowledge possessed by a firefighter.

Criteria Review

Upon completion of development of the various performance criteria instruments, a seminar was conducted for all training officers during February, 1974, at which the performance evaluation test battery was presented. All training personnel present at this seminar had been given copies of the performance package two weeks prior to the seminar. Therefore, the agenda for the seminar was concerned with a review, minor modifications, and the finalization of the completed performance evaluation package. Each jurisdiction was then told that they would be contacted individually in order to schedule the testing within their

jurisdiction. Attempts were made to coordinate the test scheduling, while at the same time, maintaining as much flexibility as possible to prevent interference with previously-scheduled jurisdictional training and testing programs.

Thus, the second objective of this study was accomplished to the extent that each of the fifteen firefighter performance dimensions, which were identified through job analysis, were included in the behaviorally-based performance evaluation checklist. Other performance evaluation instruments were constructed where ethically and economically practical.

CHAPTER V

DATA COLLECTION

Behaviorally-based Performance Evaluation Checklist

The first instrument which was administered from the performance evaluation package was the behaviorally-based performance evaluation checklist. The cooperation needed from the officers and firefighters who were to fill out this checklist was enhanced by a personal explanation of this instrument to the participating subjects. Therefore, the purpose and the intended use of the research data were explained on a station-to-station shift-by-shift basis. The firefighters were told that all research data were confidential. That is, an individual's score would be made available to neither his department heads nor the heads of his jurisdictional merit system. At this same time the firefighters were made aware of the remaining tests which were to be administered. The administration of the checklist using this method of presentation in each of the involved five jurisdictions took approximately four weeks. The checklists required that the individual, who completed the evaluation, list not only the person he was evaluating but also that he list his own name. It was explained to each subject that this was necessary for the compilation of data and that anonymity would be insured. Overall, this effort to personally explain the purpose of this research to all involved individuals was quite effective. The firefighters were asked to complete a performance evaluation checklist on each firefighter who worked in their station on their shift.

The officer in each station was also asked to complete a performance evaluation on each firefighter under his supervision. These two methods provided subjective evaluations of an individual from both a supervisory officer and a group of peers (other firefighters with whom the individual worked). This was done as a means through which to accomplish the fourth objective of the study, that being to demonstrate that two independent sets of subjective evaluations of job performance do not agree. The participating individuals were given a week in which to independently complete their evaluations.

The behaviorally-based performance evaluation checklists were then collected and scored in the following manner. Each group of five behavioral statements represented a specific firefighter job dimension, as has been previously discussed, (see also Appendix IV). Therefore, there were fifteen sections each of which contained five statements. A constant value of six was assigned to each section initially and a minus one was added to each section total for every "no" that was marked in that section. The highest possible score for any one section was a value of six and the lowest possible score was a value of one. The fifteen section scores were then combined to obtain the overall composite score of a firefighter on the evaluation (range 15 to 90).

It should be noted that when three or more "don't knows" were present in any one section, that section was preliminarily assigned a score of zero. The scores on sections having less than three "don't knows" were then computed and the average section score on that particular performance evaluation checklist was used as a final replacement for the zero value prior to summing the composite score.

There was only one supervisor composite score for each firefighter while the number of peer composite scores for each firefighter ranged from one to twelve. A maximum of five peer evaluations were included in computation of the average peer composite score. If more than five peer evaluations were available, the peer evaluations containing the most "don't knows" were dropped from the analysis. Then each of the fifteen section scores were averaged across the number of peer evaluations available, and these means were added to obtain the peer composite score. For purposes of this thesis, only the composite scores were of concern; therefore, further category score analyses were not performed. The composite scores obtained from both the peer and supervisory checklists represented two separate attempts to measure job performance as a unitary characteristic.

Objective Performance Tests

The objective performance test schedules, as well as the actual test setups, were a cooperative effort on the part of this researcher and the training officers. Training tower facilities were available in only two of the five jurisdictions. Therefore, this researcher and the training officers surveyed possible test facilities within each jurisdiction until a station was located which met the necessary situational requirements for the objective performance testing. Minor modifications were made on some of the objective performance tests within each given jurisdiction, but it was assured that the standardization of practical test administration was maintained within jurisdictions once testing was begun. Following a two- or three-day training session on

administration of the objective performance tests with the training officers, the testing of firefighters in each jurisdiction was turned over to the training officers or designated individuals in each fire department. There was a rationale for having the training personnel handle as much of this testing as possible. That was, the job performance of firefighters in the test situation was less affected under these conditions than it would have been if an outside individual or group of individuals had conducted the practical testing. In other words, outsiders could have had a motivational influence (e.g., test anxiety or not taking the test seriously) on various firefighters which would have increased or decreased performance levels. These objective performance tests were scored following the procedure shown in Table 3.

Tab Tests

Under the tab test format, subjects leave the test situation with a knowledge of the correct answers. This aspect raised a serious methodological question, that being, would the first test administration within a jurisdiction destroy the effectiveness of this technique in later administrations? In other words, would the correct answers be passed on to individuals who had not been tested? Therefore, a research strategy was developed to minimize the probability of this occurrence. Three jurisdictions operated on a two shift basis with twenty-four hours on-duty and forty-eight hours off-duty. Therefore, testing was conducted in the two-shift jurisdictions such that testing was accomplished in two consecutive days. The need for test item secrecy was stressed during the initial day of testing. In the three shift jurisdictions,

Table 3. Objective Performance Test Scoring

Test No.	Practical Test Work Sample	Scoring Procedures
Test 1	Knots and ropes	If knot is tied properly, score 60 points, then subtract the "time to tie" in seconds from 60 for each of the seven scores, then add the totals. Max range = 420.
Test 2	One man hose lay	Subtract time in seconds from "999".
Test 3	Spotting of apparatus and hook-up of soft-suction supply hose	Total time in seconds plus 30 seconds for each item checked "No" subtracted from "999".
Test 4	One man ladder handling	Total time in seconds plus 30 seconds for each bottle knocked off subtracted from "999".
Test 5	Hand traverse across a 24-foot ladder	Rung count.
Test 6	Handling of Scott-air paks	Subtract time in seconds to accomplish from "90".
Test 7	Ladder climb with weight	Subtract time to accomplish in seconds from "999".
Test 8	Ladder descent with weight	Subtract time to accomplish in seconds from "999".
Test 9	Improper and dangerous equipment storage	Record scores, range = 1,2,3. (1 pt for hose misrolled) (1 pt for noticing fire extinquisher) (1 pt for moving fire extinquisher).
Test 10	Hose and nozzle inspection	Substract "misses" from "hits" and subtract the result from "20".

testing was conducted on only two of the three shifts and over a three day period such that testing was not done on the second day. Thus, the shift which was on the second day of the test period served as a buffer between the two shifts which were tested. The tab-tests (pencil-and-paper performance tests) were administered in the individual stations on the appropriate shifts by a team of specially-trained test administrators. This was done to assure that the presentation was standardized and because the administration required a familiarity with the test instrument as well as the presentation technique. The tab-tests were considered to be power tests rather than speed tests. Adequate time was allowed for completion of each tab test. Approximately twelve minutes were allotted for reading the descriptive narrative and studying the various views of the hypothetical fire scene. Table 4 contains the times allotted for each tab test in addition to the scoring procedure. It should be noted that each individual tab test was treated in later analyses as an independent performance variable.

Job Knowledge Test and CPR

The firefighter job knowledge test and the cardio-pulmonary resuscitation first-aid test were administered by the station officers to the firefighters whom they supervised. This was done for two reasons. First, it was desirable to involve the supervisory officers in the research and, secondly, it expedited test administration and data collection. The firefighters were given fifty minutes to complete the job knowledge test and twenty minutes to complete the cardio-pulmonary resuscitation test. Both tests were examples of power tests because

Table 4. Tab-Test Scoring

Minutes to Complete	Tab-Test	Scoring Procedure
15	Pumper operator	51 minus the number of erasures.
	Firefighter Rescue Knowledge	
3	A. Possible rescue techniques	12 minus the number of erasures.
3	B. Exposure protection	13 minus the number of erasures.
5	C. Rescue equipment	39 minus the number of erasures.
	Firefighter Ventilation Knowledge	
5	A. Possible accesses	13 minus the number of erasures.
1	B. Order of ventilation	2 pts for each correct item plus 2 pts for correct placement of items 1 and 2. Total = 12.
5	C. Methods of ventilation	Record scores, range = 0 to 9.
5	D. Ventilation equipment	38 minus the number of erasures.
5	Fire suppression	14 minus the number of erasures.
5	Salvage and overhaul	20 minus the number of erasures.
5	Air-paks	49 minus the number of erasures.

all subjects completed these instruments within the allotted time. The scoring of the job knowledge test was accomplished by recording the number of correct answers (range 0 - 50). The cardio-pulmonary resuscitation (CPR) test was scored using the scoring table contained on the instrument itself (See Appendix XIII). The range of possible scores on this instrument was 0 - 27.

Sample Description and Raw Data Reduction

The subjects used in this research project were randomly selected from the total firefighter population employed by five different jurisdictional fire departments in the metropolitan Atlanta area. The 598 male firefighters who served as the sample were composed of blacks and whites. In a subsequent analysis, it was determined that black vs. white performance on the firefighter performance evaluation package did not differ significantly, thus eliminating the necessity of separate analyses. Table 5 represents a biographical description of the firefighter population used in this investigation.

Partial data were collected on 673 firefighters; however, 75 of these subjects were deleted from the sample due to missing data. The apriori criterion with regard to missing data was to discard any subject who had taken less than fifty per cent of the firefighter performance evaluation package. Several factors contributed to both subject and data loss. The total performance evaluation package required at least four different days to complete. The total time required to test each subject ranged from ten to twelve hours. The work shift scheduling, as was discussed previously, created a built-in partial data loss because

Table 5. Biographical Description of Firefighter Population

Biographical Variable	Range
Age (in years)	19 - 56
Height (in inches)	65 - 78
Weight (in pounds)	128 - 269
Education (in years)	8 - 16
Tenure (in months)	3 - 324

at least one firefighter was on a day of rest each day the tests were administered. Therefore, the reported sample size of 598 represents only those subjects who met the apriori criterion.

The raw data were first subjected to a distribution analysis in which frequency count, mean, standard deviation, range and type of distribution, as well as kurtosis and skewness were determined across the various performance evaluation instruments. The types of distributions found varied from rectangular to normal. Only the Scott air-pak handling instrument was further subjected to a square root transformation to reduce the skewness and to more nearly approach the normality of distribution. It should be noted that this transformation was performed on Scott air-pak handling distribution scores across all the jurisdictions.

Table 6 contains the raw data frequency counts, means, standard deviations, and standard scores of the sample means which were found during the distribution analyses. Even a precursory glance at this table reveals that there is a wide disparity in the number of subjects on the different variables, but this was taken into account in subsequent analyses. Also of significance are the standard errors of the sample mean which estimate the standard deviation of the sampling distribution of sample means. This information has been included for the clarification of the reader but is not germane to this thesis.

The data were then converted to standardized scores across the total sample such that each subject's relative position along the performance continuum on a given performance variable was maintained. This standardization allowed a composite analysis to be conducted using

Table 6. Firefighter Raw Data Scores

Variables	n	Mean	σ	$\sigma_{\bar{n}}$
Peer evaluation	566	82.60	7.14	.30
Supervisor evaluation	549	79.43	10.75	.45
Knots and ropes	535	271.80	79.81	3.45
One man hose lay	519	891.28	109.90	4.82
Apparatus spot and hook up	249	786.64	162.28	10.28
One man ladder handling	508	897.23	130.78	5.80
Hand traverse	524	18.21	6.67	.29
Scott air pak handling	520	29.68	42.06	1.84
Ladder climb with weight	514	856.35	158.06	6.97
Ladder descent with weight	503	868.75	223.18	9.95
Equipment storage	522	1.78	.70	.03
Equipment inspection	511	5.34	2.32	.10
Pumper tab	339	24.22	10.41	.57
Rescue technique tab	580	10.48	2.88	.12
Exposure protection tab	580	11.34	2.61	.11
Rescue equipment tab	580	17.57	8.21	.34
Ventilation access tab	580	8.81	2.95	.12
Order of ventilation	580	5.95	2.75	.11
Method of ventilation	580	3.69	1.94	.08
Ventilation equipment tab	580	26.18	8.84	.36
Fire suppression tab	578	7.15	3.92	.16
Salvage and overhaul tab	578	12,69	4.65	.19
Air pak tab	577	33.60	5.18	.21
Job knowledge	622	40.95	5.87	.24
CPR	617	19.14	4.33	.17

the total sample of firefighters. The method used to accomplish the standardization of scores on the various performance evaluation instruments is conventionally called a T-score and is illustrated in the following formula:

$$\frac{x-\bar{x}}{\sigma} * 10 + 50 = \text{T-score}$$

Where x is the raw score, $\bar{x}$ is the mean for the total sample of firefighters, and σ is the standard deviation for the total sample.

This standardization was accomplished under the stipulation that no T-score could be less than 1 or greater than 99. Thus using this transformation technique, the missing data raw scores were set equal to fifty in the analyses.

In summary, the intent was to provide at least one measure for every job dimension identified by the job analyses. Where possible, performance tests, whether objective tests or tab tests, were constructed for each dimension. Some dimensions could not be measured in this way; for example, relationships with the public. Role-playing tests were considered, but it was felt that a lack of realism would make such tests meaningless. For such dimensions, reported incidents were included in the behavioral checklist developed as a subjective performance measure. For criterion purposes, then, at least one measure was developed for every identified job dimension. Accordingly, the performance data were factor analyzed to determine what independent performance measures existed and what relationships, if any, existed between them. This procedure described in the following results section

represents the methodology chosen to accomplish the third objective of this study.

CHAPTER VI

RESULTS

The next step in the analysis of this research data was the calculation of the intercorrelation matrix among the firefighter performance variables. This intercorrelation matrix represents the relationships of every performance with every other performance and is based on all the available data. (See Table 7.)

A careful observation of the intercorrelation matrix, (see Table 7), reveals that it is essentially an example of a zero-order matrix. Of particular interest is the 0.28 correlation between the subjective performance evaluations of peers and supervisors. This is essentially the same order of correlation that would be expected based on the review of the literature which has previously been cited. In other words, this low correlation between two independent evaluators of the same performance generally seems to hold when this relationship is investigated. Furthermore, it should be pointed out that this research project probably affords a most unique opportunity to produce a high correlation between two different sets of evaluators. In most field experimentation situations where both peer and supervisory evaluations have been used, interpersonal contact normally exists for approximately eight hours per day. However, in the firefighter's situation in which the work schedule requires that the men be on duty for twenty-four hour shifts, the peers and supervisors are afforded a unique opportunity to observe in the station environment as well as at the fire scene.

Table 7. Intercorrelation Matrix of Firefighter Performance Measures

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Peer evaluation	1 100																								
Supervisor evaluation	2 28*	100																							
Knots and ropes	3 04	12*	100																						
One man hose lay	4 11	12*	08	100																					
Apparatus spot and hook up	5 07	02	04	12	100																				
One man ladder handling	6 03	04	22*	40*	13	100																			
Hand traverse	7 -03	04	05	28*	05	11	100																		
Scott air pak handling	8 07	03	18*	09	01	13	16	100																	
Ladder climb with weight	9 00	-01	11	44*	15	41*	27*	22*	100																
Ladder descent with weight	10 05	13*	04	34*	12	30*	26*	04	46*	100															
Equipment storage	11 03	01	07	-10	-16	-04	-07	03	02	-08	100														
Equipment inspection	12 13*	08	04	03	04	07	03	-01	01	04	01	100													
Pumper tab	13 -02	01	06	-02	-09	01	02	-02	16*	03	02	03	100												
Rescue technique tab	14 00	-01	-01	09	11	00	01	08	05	04	03	-02	00	100											
Exposure protection tab	15 -05	01	01	05	01	-01	08	02	06	01	-02	-01	-03	12*	100										
Rescue equipment tab	16 09	09	01	11	10	10	11	-01	12*	09	05	08	17*	10	04	100									
Ventilation access tab	17 01	00	04	09	-05	12*	08	-02	04	03	02	02	10	09	09	17*	100								
Order of ventilation	18 -01	06	00	00	-01	-04	02	05	01	-01	03	-04	-04	06	00	06	18	100							
Method of ventilation	19 12*	09	-07	-01	-10	-05	09	00	02	08	00	04	01	01	-04	05	20*	12*	100						
Ventilation equipment tab	20 -03	-07	16*	00	-07	08	04	09	21*	06	01	01	15*	04	03	20*	14*	00	-02	100					
Fire suppression tab	21 03	02	12*	03	-12	07	01	-10	03	05	-04	04	10	10	05	16*	21*	07	18*	07	100				
Salvage and overhaul tab	22 09	01	-01	05	05	03	19*	01	04	06	-02	01	08	10	10	22*	20*	05	13*	09	13*	100			
Air pak tab	23 05	-02	03	06	-03	12*	13*	05	16*	15*	-04	08	-01	04	08	02	18*	-01	07	20*	02	20*	100		
Job knowledge	24 20*	14*	16*	01	07	02	06	15*	01	-09	08	10	06	11	-04	10	12*	01	07	08	03	07	06	100	
CPR	25 20*	15*	06	07	03	02	03	07	13*	10	-02	03	17*	05	-03	16*	04	03	04	14*	06	09	10	36*	100

NOTE: Decimals omitted, n varies among individual intercorrelations as reflected in Table 6.

* Indicates intercorrelations which are significant at the .01 level.

The fact that the two sets of evaluators lived, worked, ate, and slept within close confines of the persons being evaluated, leads to an anticipated lack of independence. This was either not the case or there was low agreement as can be concluded from the rather low 0.28 correlation which was found between the peer and supervisory evaluators. This finding represents the accomplishment of the fourth objective of this study. In fact, this finding once again leads to the researcher's usual dilemma when two sets of evaluations are collected, that being, which of the evaluations is correct and should therefore be used? The coefficient of internal consistency for the peer evaluations was 0.94 while the coefficient of internal consistency for the supervisor evaluations was 0.88. Therefore, the raters were extremely stable in their evaluations of a particular firefighter's performance.

A second point of interest are the correlations between the subjective evaluations (variables 1 and 2) and the remaining twenty-three performance measures. Even a hasty inspection of the intercorrelation matrix indicates that subjective evaluations are obviously measuring something other than objective performance (as per the fifth study objective), for the correlations are virtually zero between the subjective evaluations and the other indices of performance. The exceptions to this finding were the job knowledge test and CPR test, for which there are low but significant correlations to the subjective evaluations. Variables 3 through 12 represent objective performance tests. Several of these tests had significant intercorrelations:

one man hose lay vs. one man ladder handling, 0.40

one man hose lay vs. ladder climb with weight, 0.44

one man ladder handling vs. ladder descent with weight, 0.46

Variables 13 through 23 represent the tab tests which were constructed to evaluate firefighter performance. The highest correlation between the various tab tests was 0.20. The relationships between tab tests and the objective performance tests are virtually zero. The last two variables (24 and 25) represent the other written performance tests which correlated 0.36 with each other but were virtually unrelated to the other performance indices. Therefore, the intercorrelation matrix indicates that the various performance evaluation instruments were relatively independent due to the low intercorrelations which were found; only six correlations exceeded 0.30 (4 vs. 6, 4 vs. 9, 4 vs. 10, 6 vs. 9, 9 vs. 10, and 24 vs. 25). In order to determine the relations among the various performance evaluation measures, a series of factor analyses were performed.

Cross-Validation Factor Analyses

Only 136 of the subjects had complete data across all twenty-five variables. The reason was that two of the variables (5 and 13) were designed for use only on the firefighters in the sample who were also specifically designated as fire apparatus operators. Therefore, the other twenty-three variables were designed to cover the duties of the firefighters not specifically designated as drivers. The overall cross-validation sample size using 23 variables numbered 318 firefighters and they were alternatively assigned to two groups of 159 each. This meant that firefighter subject number one in jurisdiction A was assigned to group I and subject number two to group II consecutively

through each jurisdiction. Therefore, when the cross-validation factor analyses were begun on the two groups, each group represented a composite of firefighters from all five participating jurisdictions. Two separate factor analyses were conducted using a principal axis analysis (common factor analysis) with a varimax rotation. A principal components analysis was not used because the low correlations would have introduced a great deal of specific variance into the variables and would not have approximated a common factor analysis very well.

The results of these cross-validated factor analyses were that eight factors were found for group I and nine factors were found for group II. The cross-validation factor loading matrices are presented for the reader's reference in Tables 8 and 9. The eigen roots for the two groups were as follows:

	Cross-Validation Eigen Roots									Variance Accounted For
Factor	1	2	3	4	5	6	7	8	9	
Group I	3.15	2.02	2.05	1.31	1.33	1.32	1.18	1.09		.59
Group II	2.87	2.05	1.94	1.53	1.20	1.27	1.18	1.08	1.08	.62

n = 159 in each group

The factor structure obtained from a given set of variables (in this case twenty-three performance measures) is obviously a function of the particular sample of subjects that contributed the data used to form the intercorrelation matrix. Thus, once a factor structure has been determined, the question of its stability over random samples - "factorial invariance" - quite naturally arises. Therefore, the changes

Table 8. Firefighter Cross-Validation Factor Loading Matrix

(Group I)

Variables	Factor 1	2	3	4	5	6	7	8
Peer evaluation	.04	.00	.67	-.10	.00	-.08	-.23	-.09
Supervisor evaluation	.11	-.16	.59	.10	-.03	.12	-.07	.06
Knots and ropes	.20	.08	.18	.18	-.26	.63	-.02	.19
One man hose lay	.77	.02	.04	.05	-.09	-.01	-.16	.05
One man ladder handling	.79	.06	.06	.01	-.06	.00	.00	-.14
Hand traverse	.06	.11	.01	-.02	.07	.06	.13	.78
Scott air pak handling	.21	.02	.46	-.33	.17	.38	.19	.04
Ladder climb with weight	.84	.14	.07	.03	.05	.02	.12	.03
Ladder descent with weight	.81	.04	.00	.04	.06	.00	.03	.08
Equipment storage	-.12	-.01	.00	-.03	.20	.63	-.19	-.11
Equipment inspection	-.01	.36	.35	-.10	-.17	-.17	-.08	.16
Rescue techniques tab	.04	-.14	.08	.07	.10	.04	-.69	-.15
Exposure protection tab	-.06	.21	-.04	.06	-.10	.12	-.60	.10
Rescue equipment tab	.10	.45	.12	.38	.11	.14	.14	-.37
Ventilation access tab	.09	.50	-.01	.02	.43	-.02	-.38	.11
Order of ventilation	.00	-.01	-.01	-.08	.79	.15	.06	-.06
Method of ventilation	.03	.03	.12	.31	.59	-.34	-.09	.30
Ventilation equipment tab	.06	.78	-.09	.14	-.07	.21	.11	.04
Fire suppression tab	.08	-.02	-.04	.78	.02	.08	-.04	-.02
Salvage and overhaul tab	.06	.14	.03	.52	-.01	-.16	-.21	.50
Air pak tab	.21	.57	-.04	-.20	.08	-.27	-.27	.14
Job knowledge	-.19	.20	.59	-.04	.10	.18	.03	.14
CPR	.07	-.05	.67	.16	-.01	-.08	.26	-.24

Table 9. Firefighter Cross-Validation Factor Loading Matrix

(Group II)

Variables	Factor 1	2	3	4	5	6	7	8	9
peer evaluation	.09	-.70	-.02	.16	.05	.14	.06	.18	-.14
supervisor evaluation	.11	-.73	-.11	.01	.01	.05	.13	.02	.05
Knots and ropes	.04	-.09	-.06	.25	-.06	-.38	-.08	.11	-.65
One man hose lay	.04	-.18	-.74	.01	-.02	.03	.07	-.08	.03
One man ladder handling	.00	.10	-.12	.01	.07	-.77	.06	.19	-.06
Hand traverse	.16	.03	-.69	-.08	-.13	-.21	-.16	-.16	.05
Scott air pak handling	.01	.21	-.23	-.07	.26	-.15	-.17	-.15	-.56
Ladder climb with weight	-.07	.15	-.73	-.04	.15	.01	.05	.08	-.29
Ladder descent with weight	-.13	-.28	-.41	-.06	-.45	-.00	.33	.20	.08
Equipment storage	.11	-.07	.06	-.01	.76	-.11	.18	.11	-.01
Equipment inspection	.07	-.10	.14	.00	.01	-.16	-.03	.78	.02
Rescue techniques tab	.51	.39	-.09	-.13	-.07	.10	.08	.10	-.09
Exposure protection tab	.04	-.01	-.20	-.75	.03	-.01	.02	-.15	-.04
Rescue equipment tab	.43	-.21	-.05	-.38	-.23	-.08	.20	.25	-.11
Ventilation access tab	.31	.12	-.03	.13	-.17	-.45	.44	-.25	-.12
Order of ventilation	.03	-.12	.00	.03	.07	-.06	.81	-.03	.02
Method of ventilation	.10	-.23	-.14	.57	-.05	-.05	.21	-.21	-.13
Ventilation equipment tab	.17	-.03	.05	-.13	-.14	.24	.22	-.04	-.73
Fire suppression tab	.37	.04	.19	.04	-.55	-.17	.13	.06	-.02
Salvage and overhaul tab	.64	-.06	.13	-.21	.03	-.18	.10	-.29	-.09
Air pak tab	.27	.51	-.13	.20	.06	.30	.33	.20	-.17
Job knowledge	.69	-.18	-.07	.37	.13	-.04	-.16	.09	.08
CPR	.53	-.19	-.39	.12	-.03	.16	.01	.25	-.12

in subject samples were of interest because it involved specific subpopulations of the total firefighter population who had been alternately assigned to two subgroups.

When the two factor structures to be compared are based on different samples of subjects, the correlation of factor scores is not possible, and another approach to the question of factorial invariance must be used. Kaiser (1960) developed a method of determining factorial invariance which accepts as input two factor-loading matrices derived from the same set of variables on specific subpopulations.

Veldman in his book Fortran Programming for the Behavioral Sciences gave an excellent explanation of the program RELATE.

> Kaiser's program is intended only for orthogonal sets of reference vectors. The procedure is to arbitrarily equate the origins and factor-vector orientations of the two structures, and then to determine analytically the degree of rotation of the factor axes of one of the structures which will result in a maximum degree of overlap between corresponding test vectors in the two structures. The degree of rotation necessary to achieve this criterion is expressed as a matrix of cosines of the angles between all pairs of factor axes in the two structures. Therefore, these cosines may be interpreted as correlations between the factor variables derived from the two analyses. Since the matrix of cosines is actually a transformation matrix which will carry one structure of test vectors into maximum contiguity with the other, it may be applied directly to one of the original factor structures to achieve this rotation. The resulting matrix of factor loadings could then be used to derive weights for factor-score computation. Although the rotation accomplished by this method minimizes the angles between corresponding test vectors in the two structures, one may question the success of the reorientation. The final step in the procedure yields a matrix of cosines between all pairs of test vectors after the reorientation of one of the matrices is accomplished with the initial factor-cosine matrix. Therefore, the diagonal elements of this matrix are indices of the constancy of individual tests across the two analyses (Veldman, 1967, p. 237).

The inferred coefficients of congruence of the twenty-three performance

measures between the cross-validated factor analyses are shown in Table 10.

Since the coefficients of congruence between the cross-validation factor analyses of firefighter performance tests indicated that the factor structures were so similar, based on Kaiser's suggested .40 index as an acceptable level of congruence, it was decided to use the total sample of 598 firefighters in an overall factor analysis. It should be mentioned again that the performance measurement raw scores were transformed to standardized scores prior to performing a principal factor with iteration analysis using the subprogram FACTOR PA2 option in the Univac-1100 SPSS -- Statistical Package for the Social Sciences. Table 11 shows the factor-loading matrix which was obtained by this analysis following a varimax rotation.

An interesting aspect of this factor analysis is that the variables tend to show very closely what Thurstone refers to as a "simple structure." In other words, a set of common factors displaying this property relate to the observed variables in such a way that each factor pertained as much as possible to one nonoverlapping subset of the observed variables (Mulaik, 1972). Another interesting point is that the nine eigen roots range from 2.92 to 1.04, which indicates that no overall performance factor is present. The nine eigen roots also account for 55 percent of the variance. This finding demonstrates the multidimensionality of job performance measurement as per the sixth objective of this study.

Factor I was clearly a strength and agility factor. The tests which loaded on this factor were the one man hose lay, one man ladder

Table 10. Results of Cross-Validation Congruence Analysis

Performance Measures	Coefficient of Congruence
1. Peer evaluation	.68
2. Subjective evaluation	.82
3. Knots and ropes	.66
4. One man hose lay	.79
6. One man ladder handling	.41
7. Hand traverse	.58
8. Scott air pak handling	.47
9. Ladder climb with weight	.76
10. Ladder descent with weight	.75
11. Equipment storage	.68
12. Equipment inspection	.38
14. Rescue technique tab	.37
15. Exposure protection tab	.67
16. Rescue equipment tab	.67
17. Ventilation access tab	.68
18. Order of ventilation	.81
19. Method of ventilation	.77
20. Ventilation equipment tab	.80
21. Fire suppression tab	.73
22. Salvage and overhaul tab	.68
23. Air pak tab	.93
24. Job knowledge	.79
25. CPR	.57

Table 11. Factor-Loading Matrix of Firefighter Performance Indices

Variables	Factor 1	2	3	4	5	6	7	8	9
Peer evaluation	.02	.52	.01	.04	.03	-.01	.07	.05	-.04
Supervisor evaluation	.09	.53	-.03	.04	-.12	.03	.04	-.07	.03
Knots and ropes	.05	.12	.09	-.01	.00	.47	.21	-.07	.03
One man hose lay	.58	.12	-.05	.06	-.03	.15	.01	.17	.05
Apparatus spot and hook up	.15	.08	-.07	-.16	-.05	.02	-.01	.48	.11
One man ladder handling	.48	.03	.00	.03	.09	.49	-.04	.15	-.07
Hand traverse	.38	.03	.00	.09	.07	-.07	.15	.00	.24
Scott air pak handling	.16	.01	-.04	-.04	.02	.12	.49	-.04	.09
Ladder climb with weight	.75	-.11	.26	-.03	.07	.09	.19	.04	-.01
Ladder descent with weight	.62	.12	.05	.01	.07	-.03	-.08	.00	.04
Equipment storage	-.11	.01	.07	.03	-.05	.07	.13	-.15	-.02
Equipment inspection	.02	.21	.04	.00	.08	.07	-.04	.03	-.01
Pumper tab	.04	-.01	.46	.05	-.03	.01	-.02	-.09	-.03
Rescue technique tab	.02	-.03	.05	.14	-.02	.00	.10	.20	.19
Exposure protection tab	.04	-.07	-.02	.05	.05	.02	.02	.03	.25
Rescue equipment tab	.08	.16	.40	.14	-.08	.06	-.10	.13	.30
Ventilation access tab	.02	-.02	.13	.53	.17	.13	-.03	.06	.14
Order of ventilation	.00	-.01	-.03	.27	-.06	-.03	.08	.00	.08
Method of ventilation	.07	.16	-.02	.43	.06	-.18	.00	-.14	-.01
Ventilation equipment tab	.05	-.08	.40	.00	.23	.17	.10	-.08	.14
Fire suppression tab	.01	.06	.19	.37	-.02	.14	-.17	-.06	.06
Salvage and overhaul tab	.05	.10	.13	.22	.17	-.06	-.03	.09	.36
Air pak tab	.13	.06	.03	.05	.69	.02	.02	-.03	.15
Job knowledge	-.14	.32	.22	.16	.09	.06	.44	.28	-.11
CPR	.05	.31	.39	.04	.10	-.10	.21	.15	-.12

handling, hand traverse, ladder climb with weight and ladder descent with weight.

Factor II dealt with subjective evaluation. Both the peer and supervisory evaluation loaded on this factor. It should be noted once again that the subjective evaluations of performance fall out on a separate factor.

Factor III was centered around applied technical knowledge in emergency situations. The test instruments which loaded on this factor were the pumper tab, rescue equipment tab, ventilation equipment tab, and CPR. All of these measures were concerned with what to use (e.g., proper piece of equipment or proper life-saving technique) in an emergency situation to accomplish specific tasks.

Factor IV was associated with firefighting techniques. The variables which loaded on this factor were ventilation access tab, method of ventilation tab, and the suppression tab. All of these tests were concerned with what to do and when to do it at the scene of a fire.

Factor V was a single item factor dealing with equipment troubleshooting. The only instrument loading on this factor was the air-pack tab in which subjects were required to determine what piece of equipment was malfunctioning and how to remedy the situation.

Factor VI was a skill factor. The two tests which loaded on this factor were one man ladder handling and the knots and ropes test. Both of these tests were objective performance tests and dealt with either fine or crude motor coordination (hands and fingers or combination hands, arms, and legs).

Factor VII dealt with general job knowledge. This factor had two of the variables load on it, the job knowledge test and the Scott air-pak handling objective performance test. Both of these instruments were concerned with familiarity with equipment and/or procedures.

Factor VIII was a fire apparatus operator factor which seems to differentiate the fire apparatus operator as a subpopulation of the total firefighter population. The test which loaded on this factor was the apparatus spot and hook-up objective performance instrument.

Factor IX dealt with situational problem-solving. The performance variable which loaded on this factor was the salvage and overhaul tab test. This test indicated that certain problems existed and the firefighters were required to determine a solution which would correct the difficulty.

The actual reliabilities of the twenty-five instruments which composed the total firefighter performance evaluation package were not computed for inclusion in this thesis and no way has been devised to estimate the reliabilities of the tab tests. Therefore, since there was no direct calculation of reliabilities, it was decided to use an indirect inferential technique as a method to address the question of instrument reliabilities. This was accomplished using the default option (PA2) of the subprogram FACTOR in the Univac-1100 SPSS -- Statistical Package for the Social Sciences. To clarify, the PA2 option of the subprogram FACTOR determines the number of factors to be extracted from the original or unreduced intercorrelation matrix. The program then replaces the main diagonal elements of the intercorrelation matrix with initial estimates of communalities, the R^2 estimates. Next it

extracts the same number of factors from this reduced matrix, and the variances accounted for by these factors become new communality estimates. The diagonal elements are then replaced with these new communalities. This process continues until the differences in the two successive communality estimates are negligible. Following twenty-five iterations, the resulting communalities shown in Table 12 can then be viewed as lower-bound estimates of the reliability of the various test instruments which were developed and used in this research project.

Using the principal factor method of analysis, twenty-five factors were extracted. The eigenvalues of these unrotated factors are shown in Table 13. Therefore, following the determination of the final communalities, these lower-bound estimates were inserted in the main diagonal of the R matrix and a varimax rotation was performed rotating only those nine factors which were found to have an unrotated eigenvalue of greater than 1.0. The resulting "column sum of squares" associated with the loadings of the rotated factors are shown in Table 14. These sum of squares divided by the number of variables gives an index of the percentage of total variance accounted for by each of the orthogonal factors. The maximum percentage of the total variance accounted for by a single common factor was 0.26.

Table 12. Firefighter Performance Evaluation Battery

Lower-Bound Estimates of Reliability

Variables	Communalities
Peer evaluation	.28
Supervisor evaluation	.31
Knots and ropes	.29
One man hose lay	.41
Apparatus spot and hook up	.31
One man ladder handling	.51
Hand traverse	.24
Scott air pak handling	.30
Ladder climb with weight	.70
Ladder descent with weight	.41
Equipment storage	.07
Equipment inspection	.06
Pumper tab	.22
Rescue technique tab	.11
Exposure protection tab	.08
Rescue equipment tab	.34
Ventilation access tab	.37
Order of ventilation	.09
Method of ventilation	.27
Ventilation equipment tab	.29
Fire suppression tab	.24
Salvage and overhaul tab	.25
Air pak tab	.53
Job knowledge	.50
CPR	.36

Table 13. Unrotated Eigenvalues of Firefighter Performance Indices*

Factor	Factor Name	Eigen Value	Percent of Variance
1	Strength and agility	2.92	11.7
2	Subjective evaluation	1.91	7.6
3	Applied technical knowledge	1.61	6.5
4	Firefighting techniques	1.42	5.7
5	Trouble-shooting	1.25	5.0
6	Skills	1.22	4.9
7	General job knowledge	1.16	4.6
8	Fire apparatus operator	1.10	4.4
9	Situational problem-solving	1.02	4.1
	54.5 % of the total variance accounted for by factors having eigenvalues greater than 1.0		
10		.99	4.0
11		.95	3.8
12		.92	3.7
13		.89	3.6
14		.84	3.4
15		.79	3.2
16		.77	3.1
17		.75	3.0
18		.73	2.9
19		.65	2.6
20		.61	2.4
21		.58	2.3
22		.55	2.2
23		.51	2.0
24		.47	1.9
25		.37	1.5

* Eigenvalues of R matrix with 1's in the major diagonal.

Table 14. Column Sum of Squares of Firefighter Performance Indices

Factor	Column Sum of Squares	Percent of Variance
1	2.35	31.2
2	1.28	17.0
3	.94	12.5
4	.72	9.6
5	.57	7.5
6	.50	6.7
7	.48	6.4
8	.42	5.6
9	.27	3.6

CHAPTER VII

DISCUSSION

The first objective of this study was to identify the dimensions of firefighter performance. The PAQ and CIT job analytic techniques yielded fifteen firefighter job performance dimensions. Support for the adequacy of this approach was provided by the Murdy and Norton (1972) job analysis of the Fort Worth fire service, as well as the metropolitan Atlanta training officer consensus which was obtained.

The second objective set for this study was to develop at least one performance measure for every job dimension identified through the job analyses which were performed. The 75-item performance evaluation checklist used in this study was constructed using five behaviorally-based dichotomous statements identified by the critical incident methodology. It should be reiterated that the checklist was designed to evaluate all fifteen job performance dimensions. Some of the dimensions identified (Remains calm in personally demanding situations and Ability to work effectively in a hazardous unpleasant environment) could be ethically evaluated only in this manner. Due to the artificiality of the required testing situation (e.g., role-playing) other dimensions (Relationships with peers and public, Helping others learn, Interest in learning, Willingness and eagerness to do their part of the work at the station and/or fire, and Professionalism) were also assessed only with the checklist. More objective measures (e.g., tab-tests and objective performance tests) were constructed on the remaining job performance

dimensions when the situation dictated their ethical and economic practicality.

The third objective was to determine if job performance can be measured as a unitary characteristic or if measures of job performance are independent of each other. The results of this study give support to the contention that job performance can only be effectively evaluated using a multidimensional approach to job performance measurement. The support is in the form of a factor analysis performed on the intercorrelation matrix of twenty-five performance evaluation instruments. This analysis indicated that at least nine different indices of performance were present and that they accounted for 54.5 per cent of the total variability. The remaining forty-five per cent of the variability probably represents the nine dimensions which could not be covered with objective and/or pencil-and-paper performance measures. The eigen roots (ranging from 2.92 to 1.04) found during the factor analysis of the intercorrelation matrix of firefighter performance measures indicated the absence of an overall performance factor. This finding represents the accomplishment of the sixth study objective, that being to demonstrate the multidimensionality of job performance.

The correlation between the two independent sets of subjective evaluations (0.28) falls within the range found in the literature survey, even though the evaluators were afforded a unique opportunity to observe. Therefore, the fourth study objective dealing with the relationship between two independent sets of evaluators was considered. However, really concrete conclusions cannot be drawn in regard to the resultant low correlation between the two independent sets of evaluators

in this study. Without peer-peer or supervisor-supervisor correlations, it is hard to evaluate whether the result is not simply due to low interrater reliability in general. The more important aspect of this finding is simply that interrater reliability of the same individual's performance, though significantly correlated, is lower than might have been intuitively hypothesized in this situation.

The relationships between the subjective evaluations of job performance and the remaining objective indices of performance represent the fifth research objective. The extremely low inter-correlations between subjective evaluations and the remaining objective indices of performance are also consistent with previously reported findings. The question therefore arises as to what is being subjectively evaluated; it is obviously not objective performance to any high degree. Also, the two variables dealing with the performance evaluation check-list loaded on only one factor, as always seems to be the case. It is acknowledged that this finding may have resulted from method variance (Jackson, 1969), but more importantly, this factor accounted for less than eight per cent of the total variability. Hence, two conclusions seem evident with regard to subjective evaluations:

1) Subjective evaluations should not be used as the sole indicator of performance levels because of the high complexity of job performance.
2) Subjective evaluations should probably be included in a multidimensional performance evaluation package because they do account for a portion of the variability, the actual content of which has yet to be interpreted.

The firefighter performance evaluation intercorrelation matrix indicated that the relationships among the various performance measures were much lower than would have been intuitively hypothesized. This finding gives credibility to the exploratory nature of this investigation. The two sets of subjective evaluations collected using the same instrument on two different sets of evaluators were correlated at only 0.28. Even among the more objective performance measures, some of which at face value seemed highly similar (e.g., Ladder climb with weight versus Ladder descent with weight), only five intercorrelations were above 0.30. The eleven tab tests, whose method was constant but whose content was varied, produced only one intercorrelation which was above 0.20. The two written performance measures (job knowledge and CPR) only correlated at 0.36. Hence, a factor analysis of the resultant performance evaluation intercorrelation matrix produced nine rather well-defined factors with only one of the twenty-five performance variables loading on more than one factor.

Since some of the test instruments which were developed overlapped various identified critical incident dimensions, there was also some overlap between dimensions and the factors which were identified through factor analysis. For example, the specialized job knowledge dimenion was evident in factors II, III, IV, V, VI, VII, and was possibly present in factors VIII and IX. In other words, the specialized job knowledge dimension must represent the basic structure underlying at least six, possibly eight, of the factors which were found. The Respect for property and equipment dimension was thought to be covered by the equipment storage and inspection of instruments, but they failed

to load on any of the identified factors. Factor I obviously accounted for the dimension Ability to perform physically demanding tasks. Factor II covers the dimension Ability to follow orders. The dimension dealing with the ability to make correct decisions obviously pertains to factors III and IX, respectively. The dimension Responsibility for the safety of others was presumed covered by the rescue techniques and exposure protection tabs, but they also failed to load on any of the factors identified.

It should be noted that five of the performance variables (equipment storage, equipment inspection, rescue techniques tab, exposure protection tab, and order of ventilation tab) failed to load under the principal factor analysis on any of the nine factors identified (see Table 11). Certain inferences can be drawn from this finding. First, the two objective performance tests dealing with equipment storage and inspection were "trick" tests in the sense that they required extreme attention to detail or some insight into what was really being tested. Also the lower-bound estimates of reliability on these two instruments were much lower than the other performance indices indicating the presence of high amounts of unique variance (see Table 12). Second, the order-of-ventilation test was administered with a one-minute time limit for completion. The combination of problems associated with reading comprehension and retention of material probably explains why this test also did not produce a reliable measure of performance.

A finding of special significance was noted with regard to the tab test instruments. The only two tab tests (rescue technique tab and

exposure protection) which failed to load on any of the identified factors were also the only tab tests which contained one correct alternative from among a set of possible alternatives. This coupled with the lower estimates of reliability on these two instruments, (see Table 12), indicates that if tab tests are to be constructed, they must contain more than one correct alternative. The rationale for this observation is based on a review of Table 12 in which the other tab tests having more correct alternatives possessed lower-bound estimates of reliability on the order of three times higher than those tab tests having only one correct alternative.

The possibility exists that the tab item reliability estimates are seriously underestimated. On some of the tests all correct and no incorrect alternatives were selected by approximately one-half the subjects. In such cases, the item is invariant for that group and has a reliability of 1.00. Hence, it seems likely that the tab items have reliabilities much higher than the calculated lower-bound estimates.

The major objective of this thesis was to provide a rational multidimensional research strategy through which to accomplish both job analysis and job performance evaluation. The results which have been presented indicate the research strategy employed in this thesis to be a viable approach to performance measurement.

CHAPTER VIII

IMPLICATIONS

The implications from this study suggest that job analyses can be put to far greater use in building objective performance tests than is currently the norm. The firefighter objective performance tests covered ten specific job tasks which on the surface appeared highly similar, but upon analysis were found to be quite varied as evidenced by the intercorrelation matrix.

The objective performance tests were, by design, physically demanding for the PAQ analysis indicated that a high level of physical exertion was required for the job. Also incorporated in the objective tests was the assessment of other performance aspects (e.g., skills, techniques, handling procedures, etc.). Therefore, the results obtained indicate that after performance dimensions have been identified, using both the CIT and PAQ methodology, they can be used to develop rather independent objective performance tests which cover some of the specific job tasks and/or responsibilities.

The use of the tab test format holds real promise in the evaluation of technical competence and integrative problem-solving abilities of highly-skilled job incumbents. Although originally developed and used in the late 1940's, the tab test approach has been dormant, as evidenced by the literature, for over twenty years. The findings in this study indicate that interest in the development and use of tab tests in performance measurement should be rekindled. Support for this

argument is based on the low intercorrelations among the eleven tab tests. This indicates that tab instruments can be constructed to measure independent performance dimensions.

Tab tests are contingent upon constraints which make certain alternatives correct and other alternatives incorrect. These constraints are flexible to the extent that variations in the technical input easily modifies the constraints, thus changing the correct alternative. Tab tests also serve the dual function of simultaneously evaluating and training the subject, as has been previously noted. There is from a psychometric viewpoint, however, a problem with the tab test approach to performance measurement which needs to be addressed; that is, the need for a methodology whereby the reliability of this measurement technique can be statistically demonstrated.

This analysis of a multidimensional approach to job performance measurement uncovered at least eight firefighter performance factors and one additional factor which seemed to differentiate the fire apparatus operator from the firefighter. In a practical sense, the identification of these nine factors from an intercorrelation matrix of twenty-five performance evaluation instruments indicates: (1) a multidimensional assessment of the firefighter's job performance and (2) that firefighter performance factors might be adequately measured by using the one performance evaluation instrument having the highest loading on a particular factor. For example, factor I might be measured adequately using only Ladder climb with weight; factor II - Supervisor evaluation; factor III - Pumper tab; factor IV - Ventilation access tab; factor V - Air pak handling; factor VIII - Apparatus spot and hook up;

and factor IX - Salvage and overhaul tab. In other words, an abbreviated version of the firefighter performance evaluation package containing nine versus twenty-five performance evaluation instruments might be just as effective as the total package. This condensed version of the total firefighter performance evaluation battery might then be used in situations where practical and/or economic limitations prevent use of the entire package.

The performance evaluation methodology outlined in this study is extremely flexible and can be used on many different job classifications (i.e., police, clerical, mechanics, etc.). With all the current emphasis being placed on the validation of selection tests and screening devices, a combination of tab tests and objective performance tests can be used not only as performance evaluation instruments but also as "job-related" pre-employment screening devices which have the necessary face validity to be practically acceptable.

The multidimensional approach to job performance measurement has certain innate benefits in that it recognizes that all human beings have strengths and weaknesses in regard to their job performance (e.g., individual differences). By assessing individuals over many different job performance dimensions, individuals who are strong in some dimensions can compensate for being weak in other dimensions. Once the time and effort has been expended in developing performance evaluation batteries, their use could be expanded from validation research. After mean levels of performance have been established, the performance evaluation package might be used to replace the annual merit rating system, currently in use throughout the United States. It would provide

a more objective means of determining individuals who are deserving of merit raises or pay increases. Further, a series of these annual performance evaluations might then be used for promotional purposes, thus allowing the more qualified employees to be singled out for promotions. A final contribution which could be gained through adoption of the performance evaluation battery is that it may serve to identify deficiencies in established training programs. All things considered, this multidimensional approach to job performance measurement seems potentially to be an extremely practical contribution to the field of performance evaluation.

APPENDICES

APPENDIX I

FIREFIGHTER PAQ RESULTS

PAQ NUMBER = 701567
ORGANIZATION
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 8/17/73
ANALYST(S) =
NUMBER OF ANALYSTS = 3

DATA DERIVED FROM THE POSITION ANALYSIS QUESTIONNAIRE (PAQ)

ITEM CHECK = ALL PAQ ITEMS ARE COMPLETED

SPECIAL ITEMS = THE FOLLOWING ITEMS MAY PROVIDE HELPFUL INFORMATION

ITEM	MEANING OF ITEM	SCORE	MEANING OF SCORE
20.	NEAR VISUAL DIFFERENTIATION	3.0	MODERATE DETAIL
22.	DEPTH PERCEPTION (IMPORTANCE)	4.3	HIGH IMPORTANCE
23.	COLOR PERCEPTION (IMPORTANCE)	3.3	AVERAGE IMPORTANCE
46.	EDUCATION (LEVEL OR EQUIV)	2.3	HGH SCHOOL DIPLOMA
47.	JOB-RELATED EXPERIENCE	1.0	LESS THAN 1 MONTH
48.	TRAINING (TIME TO LEARN JOB)	3.0	6 MONTHS TO 1 YEAR
49.	USING MATHEMATICS (LEVEL)	2.7	INTERMEDIATE
87.	LEVEL OF PHYSICAL EXERTION	4.7	VERY HEAVY
92.	KNEELING/STOOPING (TIME)	1.3	UNDER 1/10 OF TIME
128.	SUPRVIS OF NON-SUPRVISRY PERS	3.7	9 TO 12 WORKERS
129.	DIRECTION OF SUPERVISORY PERS	2.0	3 TO 5 SUP PERS
130.	TOTL NUM OF PERS FOR WHM RESP	0.7	1 TO 10 WORKERS
134.	SUPERVISION RECEIVED	0.7	IMMEDIATE SUPERVSN
143.	NOISE INTENSITY	3.7	LOUD

PREDICTED VALUES = MEAN TEST SCORE, STD. DEV. OF TEST SCORES, VALIDITY COEF., USE IN SELECTION, CUTTING SCORE.

NAME OF TEST	PRED. MEAN TEST SCORE	STD ERROR OF EST.	PRED. STD. DEV. OF TEST SCORES	STD ERROR OF EST.	PRED. VALID. COEF.	STD ERR OF EST.	PRED. USE IN SELECTION	STD ERR OF EST.	PRED. CUTTING SCORE
G=INTELLIGENCE	106.64	8.11	13.31	1.66	0.31	0.14	1.17	0.40	93
V=VERBAL APTITUDE	98.78	7.03	13.16	1.80	0.26	0.15	0.58	0.36	86
N=NUMERICAL APT.	103.17	8.40	15.51	1.78	0.22	0.13	0.94	0.43	88
S=SPATIAL APTITUDE	106.79	7.83	14.56	1.72	0.14	0.13	0.21	0.36	
P=FORM PERCEPTION	94.35	8.82	15.01	1.89	0.21	0.13	-0.11	0.37	
Q=CLERICAL PERCEPT	100.28	8.21	12.73	1.29	0.16	0.13	0.24	0.39	
K=MOTOR COORDINAT	95.72	7.09	17.38	1.97	0.18	0.12	0.23	0.39	
F=FINGER DEXTERITY	91.87	7.19	16.58	1.83	0.20	0.12	0.28	0.36	
M=MANUAL DEXTERITY	98.70	6.89	21.95	2.36	0.18	0.14	0.16	0.40	

JOB EVALUATION = PREDICTED JOB EVALUATION POINTS = 843.87 STANDARD ERROR OF ESTIMATE = 170.00

WARNING = THE JOB EVALUATION PREDICTIONS SHOULD BE INTERPRETED WITH CAUTION. SEE THE PAQ USER'S MANUAL AND THE TECHNICAL MANUAL.

PAY NUMBER = 701561
ORGANIZATION
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 6/17/73
ANALYST(S) =
NUMBER OF ANALYSTS = 3

JOB PROFILE (DIMENSION SCORES PLOTTED BY PERCENTILE, Z-SCORE, DESCRIPTION)

DIVISION JOB DIMENSIONS	DIM SCORE	PERCENTILE .1 1 5 10 20 30 40 50 60 70 80 90 95 99 99.9	STD. ERR OF MEAS
A -1 MATCHING DEVICES/MATERIALS FOR INFORMATION	-0.966		0.77
A- 2 INTERPRETING WHAT IS HEARD OR SEEN	1.781		0.73
A- 3 USING DATA ORIGINATING WITH PEOPLE	-0.258		0.56
A- 4 MATCHING THINGS FROM A DISTANCE	0.427		0.26
A- 5 EVALUATING INFORMATION FROM THINGS	0.755		0.43
A- 6 BEING AWARE OF ENVIRONMENTAL CONDITIONS	2.783		2.08
A- 7 BEING AWARE OF BODY MOVEMENT AND BALANCE	3.986		0.73
A- 8 MAKING DECISIONS	-0.044		0.54
A- 9 PROCESSING INFORMATION	0.908		0.52
C-10 CONTROLLING MACHINES/PROCESSES	-0.476		0.37
C-11 USING HANDS AND ARMS TO CONTROL/MODIFY	0.750		0.93
C-12 USING FEET/HANDS TO OPERATE EQUIP/VEHICLES	3.785		0.51
C-13 PERFORMING ACTIVITIES REQUIRING GEN BODY MOVE	2.955		0.20
C-14 USING HANDS & ARMS TO MOVE/POSITION THINGS	-0.969		0.55
C-15 USING FINGERS VS GENERAL BODY MOVEMENT	-0.767		0.52
C-16 PERFORMING SKILLED/TECHNICAL ACTIVITIES	1.225		0.32
D-17 COMMUNICATING JUDGEMENTS, DECISIONS, INFORM	1.131		0.40
D-18 EXCHANGING JOB-RELATED INFORMATION	1.156		0.79
D-19 PERFORMING STAFF/RELATED ACTIVITIES	-0.829		1.47
D-20 CONTACTING SUPERVISOR OR SUBORDINATES	0.075		0.66
D-21 DEALING WITH THE PUBLIC	1.603		0.44
E-22 BEING IN A HAZARDOUS/UNPLEASANT ENVIRONMENT	3.770		0.38
E-23 ENGAGING IN PERSONALLY DEMANDING SITUATIONS	2.461		0.56
E-24 ENGAGING IN BUSINESSLIKE WORK SITUATIONS	-0.084		0.10
E-25 BEING ALERT TO DETAIL/CHANGING CONDITIONS	1.355		0.20
E-26 PERFORMING UNSTRUCTURED VS STRUCTURED WORK	0.038		0.56
E-27 WORKING ON A VARIABLE VS REGULAR SCHEDULE	-0.542		0.06
OVERALL JOB DIMENSIONS			
O-28 HAVING DECISION MAKING, COMMUN, & SOCIAL RESP	1.536		0.39
O-29 PERFORMING SKILLED ACTIVITIES	-0.220		0.45
O-30 BEING PHYS ACTIVE/RELATED ENVIRON CONDITION	3.518		0.21
O-31 OPERATING EQUIPMENT/VEHICLES	2.496		0.29
O-32 PROCESSING INFORMATION	1.215		0.41
Z-SCORE:		-3 -2 -1 0 +1 +2 +3	
DESCRIP- TION:		EXTREMELY LOW VERY LOW LOW AVERAGE HIGH VERY HIGH EXTREMELY HIGH	

THE DASHES (-) WHICH BRACKET THE X'S INDICATE THE STANDARD ERROR OF MEASUREMENT.
THE 0 INDICATES THAT THE JOB DIMENSION SCORE EXCEEDS THE GRAPH LIMITS.

PAQ NUMBER = 701504
ORGANIZATION =
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 8/17/77
ANALYST(S) =
NUMBER OF ANALYSTS = 3

DATA DERIVED FROM THE POSITION ANALYSIS QUESTIONNAIRE (PAQ)

ITEM CHECK = ALL PAQ ITEMS WERE COMPLETED

SPECIAL ITEMS = THE FOLLOWING ITEMS MAY PROVIDE HELPFUL INFORMATION

ITEM	MEANING OF ITEM	SCORE	MEANING OF SCORE
20.	NEAR VISUAL DIFFERENTIATION	2.7	MODERATE DETAIL
23.	COLOR PERCEPTION (IMPORTANCE)	3.3	AVERAGE IMPORTANCE
46.	EDUCATION (LEVEL OR EQUIV)	3.0	SOME COLLEGE EDUC
47.	JOB-RELATED EXPERIENCE	0.7	LESS THAN 1 MONTH
48.	TRAINING (TIME TO LEARN JOB)	2.7	6 MONTHS TO 1 YEAR
49.	USING MATHEMATICS (LEVEL)	3.3	INTERMEDIATE
87.	LEVEL OF PHYSICAL EXERTION	4.3	HEAVY
92.	KNEELING/STOOPING (TIME)	1.0	UNDER 1/10 OF TIME
128.	SUPERVIS OF NON-SUPERVISRY PERS	0.7	1 OR 2 WORKERS
129.	DIRECTION OF SUPERVISORY PERS	0.7	1 OR 2 SUP PERS
134.	SUPERVISION RECEIVED	2.3	GENERAL SUPERVISN

PREDICTED VALUES = MEAN TEST SCORE, STD. DEV. OF TEST SCORES, VALIDITY COEF., USE IN SELECTION, CUTTING SCORE.

NAME OF TEST	PRED. MEAN TEST SCORE	STD ERROR OF EST.	PRED. STD. DEV. OF TEST SCORES	STD ERROR OF EST.	PRED. VALID. COEF.	STD ERR OF EST.	PRED. USE IN SELECTION	STD ERR OF EST.	PRED. CUTTING SCORE
G=INTELLIGENCE	103.43	8.11	14.50	1.66	0.35	0.14	1.12	0.40	89
V=VERBAL APTITUDE	103.09	7.03	14.23	1.80	0.29	0.15	0.39	0.36	
N=NUMERICAL APT.	99.23	8.40	15.56	1.78	0.31	0.13	0.80	0.43	84
S=SPATIAL APTITUDE	106.15	7.83	16.66	1.72	0.26	0.13	0.26	0.36	
P=FORM PERCEPTION	98.84	8.82	15.22	1.89	0.29	0.13	0.04	0.37	
Q=CLERICAL PERCEPT	96.56	8.21	13.49	1.29	0.25	0.13	0.25	0.39	
K=MOTOR COORDINAT	99.42	7.09	17.37	1.97	0.22	0.12	0.31	0.39	
F=FINGER DEXTERITY	96.42	7.19	17.91	1.83	0.24	0.12	0.43	0.36	79
M=MANUAL DEXTERITY	99.83	6.89	20.43	2.36	0.20	0.14	0.30	0.40	

JOB EVALUATION = PREDICTED JOB EVALUATION POINTS = 762.12 STANDARD ERROR OF ESTIMATE = 150.00

WARNING = THE JOB EVALUATION PREDICTIONS SHOULD BE INTERPRETED WITH CAUTION. SEE THE PAQ USER'S MANUAL AND THE TECHNICAL MANUAL.

PAQ NUMBER = 701504
ORGANIZATION =
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 8/1//73
ANALYST(S) =
NUMBER OF ANALYSTS = 3

JOB PROFILE (DIMENSION SCORES PLOTTED BY PERCENTILE, Z-SCORE, DESCRIPTION)

DIVISION JOB DIMENSIONS	DMN SCORE	PERCENTILE .1 1 5 10 20 30 40 50 60 70 80 90 95 98 99.9	STD. ERR OF MEAS
A =1 WATCHING DEVICES/MATERIALS FOR INFORMATION	-0.443		0.52
A= 2 INTERPRETING WHAT IS HEARD OR SEEN	1.806		0.48
A= 3 USING DATA ORIGINATING WITH PEOPLE	1.427		0.46
A= 4 WATCHING THINGS FROM A DISTANCE	0.571		0.44
A= 5 EVALUATING INFORMATION FROM THINGS	-0.043		0.61
A= 6 BEING AWARE OF ENVIRONMENTAL CONDITIONS	2.414		0.74
A= 7 BEING AWARE OF BODY MOVEMENT AND BALANCE	1.488		0.94
A= 8 MAKING DECISIONS	0.483		0.56
A= 9 PROCESSING INFORMATION	-0.361		0.62
C=10 CONTROLLING MACHINES/PROCESSES	0.127		0.58
C=11 USING HANDS AND ARMS TO CONTROL/ADJUST	0.994		0.82
C=12 USING FEET/HANDS TO OPERATE EQUIP/VEHICLES	3.232		0.42
C=13 PERFORMING ACTIVITIES REQUIRING GEN BODY MOVE	1.918		0.56
C=14 USING HANDS & ARMS TO MOVE/POSITION THINGS	-0.797		0.57
C=15 USING FINGERS VS GENERAL BODY MOVEMENT	-0.461		0.42
C=16 PERFORMING SKILLED/TECHNICAL ACTIVITIES	0.559		0.44
D=17 COMMUNICATING JUDGEMENTS, DECISIONS, INFORM	0.024		0.47
D=18 EXCHANGING JOB-RELATED INFORMATION	2.389		1.03
D=19 PERFORMING STAFF/RELATED ACTIVITIES	0.357		1.00
D=20 CONTACTING SUPERVISOR OR SUBORDINATES	-0.291		0.58
D=21 DEALING WITH THE PUBLIC	1.596		0.80
E=22 BEING IN A HAZARDOUS/UNPLEASANT ENVIRONMENT	3.252		0.42
E=23 ENGAGING IN PERSONALLY DEMANDING SITUATIONS	2.649		0.44
E=24 ENGAGING IN BUSINESSLIKE WORK SITUATIONS	-0.051		0.32
E=25 BEING ALERT TO DETAIL/CHANGING CONDITIONS	0.773		0.50
E=26 PERFORMING UNSTRUCTURED VS STRUCTURED WORK	-1.271		0.46
E=27 WORKING ON A VARIABLE VS REGULAR SCHEDULE	-0.127		0.24
OVERALL JOB DIMENSIONS			
O=28 HAVING DECISION MAKING, COMMUN, & SOCIAL RESP	1.268		0.37
O=29 PERFORMING SKILLED ACTIVITIES	0.086		0.32
O=30 BEING PHYS ACTIVE/RELATED ENVIRON CONDITION	2.898		0.43
O=31 OPERATING EQUIPMENT/VEHICLES	1.729		0.43
O=32 PROCESSING INFORMATION	0.586		0.45
	Z-SCORE:	-3 -2 -1 0 +1 +2 +3	
	DESCRIP:	EXTREMELY VERY VERY EXTREMELY	
	HIGH	LOW LOW LOW AVERAGE HIGH HIGH HIGH	

THE DASHES (-) WHICH BRACKET THE X'S INDICATE THE STANDARD ERROR OF MEASUREMENT.
THE 0 INDICATES THAT THE JOB DIMENSION SCORE EXCEEDS THE GRAPH LIMITS.

PAQ NUMBER = 70151U
ORGANIZATION
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 4/17/73
ANALYST(S) =
NUMBER OF ANALYSTS = 3

DATA DERIVED FROM THE POSITION ANALYSIS QUESTIONNAIRE (PAQ)

ITEM CHECK = ALL PAQ ITEMS WERE COMPLETED

SPECIAL ITEMS = THE FOLLOWING ITEMS MAY PROVIDE HELPFUL INFORMATION

ITEM	MEANING OF ITEM	SCORE	MEANING OF SCORE
20.	NEAR VISUAL DIFFERENTIATION	3.0	MODERATE DETAIL
22.	DEPTH PERCEPTION (IMPORTANCE)	4.0	HIGH IMPORTANCE
23.	COLOR PERCEPTION (IMPORTANCE)	4.0	HIGH IMPORTANCE
46.	EDUCATION (LEVEL OR EQUIV)	2.3	HIGH SCHOOL DIPLOMA
47.	JOB-RELATED EXPERIENCE	-	DOES NOT APPLY
48.	TRAINING (TIME TO LEARN JOB)	1.3	1 TO 30 DAYS
49.	USING MATHEMATICS (LEVEL)	3.3	INTERMEDIATE
87.	LEVEL OF PHYSICAL EXERTION	4.3	HEAVY
92.	KNEELING/STOOPING (TIME)	1.3	UNDER 1/10 OF TIME
134.	SUPERVISION RECEIVED	1.0	IMMEDIATE SUPERVSN
143.	NOISE INTENSITY	4.0	LOUD

PREDICTED VALUES = MEAN TEST SCORE, STD. DEV. OF TEST SCORES, VALIDITY COEF., USE IN SELECTION, CUTTING SCORE.

NAME OF TEST	PRED. MEAN TEST SCORE	STD ERROR OF EST.	PRED. STD. DEV. OF TEST SCORES	STD ERROR OF EST.	PRED. VALID. COEF.	STD ERR OF EST.	PRED. USE IN SELECTION	STD ERR OF EST.	PRED. CUTTING SCORE
G=INTELLIGENCE	103.84	8.11	14.19	1.66	0.36	0.14	1.07	0.40	90
V=VERBAL APTITUDE	103.60	7.03	14.93	1.80	0.25	0.15	0.60	0.36	89
N=NUMERICAL APT.	100.20	8.40	16.24	1.78	0.28	0.13	0.82	0.43	84
S=SPATIAL APTITUDE	101.25	7.83	16.00	1.72	0.19	0.13	0.05	0.36	
P=FORM PERCEPTION	100.60	8.82	16.00	1.89	0.33	0.13	0.82	0.37	
Q=CLERICAL PERCEPT	102.22	8.21	12.86	1.29	0.25	0.13	0.49	0.39	
K=MOTOR COORDINAT	101.03	7.69	17.50	1.97	0.22	0.12	0.52	0.39	
F=FINGER DEXTERITY	96.60	7.19	16.98	1.83	0.25	0.12	0.46	0.36	
M=MANUAL DEXTERITY	101.15	6.89	22.12	2.36	0.14	0.14	-0.03	0.40	

JOB EVALUATION = PREDICTED JOB EVALUATION POINTS = 651.00 STANDARD ERROR OF ESTIMATE = 130.00

WARNING = THE JOB EVALUATION PREDICTIONS SHOULD BE INTERPRETED WITH CAUTION. SEE THE PAQ USER'S MANUAL AND THE TECHNICAL MANUAL.

PAQ NUMBER = 701510
ORGANIZATION
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 8/17/73
ANALYST(S) =
NUMBER OF ANALYSIS = 3

JOB PROFILE (DIMENSION SCORES PLOTTED BY PERCENTILE, Z-SCORE, DESCRIPTION)

DIVISION JOB DIMENSIONS	DMN SCORE	PERCENTILE .1 1 5 10 20 30 40 50 60 70 80 90 95 98 99.9	STD. ERR OF MEAS
A =1 MATCHING DEVICES/MATERIALS FOR INFORMATION	-0.958		0.52
A= 2 INTERPRETING WHAT IS HEARD OR SEEN	2.706		0.85
A= 3 USING DATA ORIGINATING WITH PEOPLE	1.044		0.45
A= 4 MATCHING THINGS FROM A DISTANCE	0.650		0.44
A= 5 EVALUATING INFORMATION FROM THINGS	1.180		0.61
A= 6 BEING AWARE OF ENVIRONMENTAL CONDITIONS	4.026		0.74
A= 7 BEING AWARE OF BODY MOVEMENT AND BALANCE	4.361		0.94
A= 8 MAKING DECISIONS	-0.239		0.56
A= 9 PROCESSING INFORMATION	1.209		0.62
C=10 CONTROLLING MACHINES/PROCESSES	-0.312		0.58
C=11 USING HANDS AND ARMS TO CONTROL/MODIFY	0.670		0.62
C=12 USING FEET/HANDS TO OPERATE EQUIP/VEHICLES	2.926		0.42
C=13 PERFORMING ACTIVITIES REQUIRING GEN BODY MOVE	3.203		0.56
C=14 USING HANDS & ARMS TO MOVE/POSITION THINGS	-0.703		0.57
C=15 USING FINGERS VS GENERAL BODY MOVEMENT	-0.881		0.62
C=16 PERFORMING SKILLED/TECHNICAL ACTIVITIES	0.705		0.44
O=17 COMMUNICATING JUDGEMENTS, DECISIONS, INFORM	-0.560		0.47
O=18 EXCHANGING JOB-RELATED INFORMATION	3.264		1.03
O=19 PERFORMING STAFF/RELATED ACTIVITIES	1.883		1.00
O=20 CONTACTING SUPERVISOR OR SUBORDINATES	-0.085		0.55
O=21 DEALING WITH THE PUBLIC	4.004		0.80
E=22 BEING IN A HAZARDOUS/UNPLEASANT ENVIRONMENT	3.333		0.42
E=23 ENGAGING IN PERSONALLY DEMANDING SITUATIONS	2.668		0.44
E=24 ENGAGING IN BUSINESSLIKE WORK SITUATIONS	-0.228		0.32
E=25 BEING ALERT TO DETAIL/CHANGING CONDITIONS	1.914		0.50
E=26 PERFORMING UNSTRUCTURED VS STRUCTURED WORK	-1.198		0.46
E=27 WORKING ON A VARIABLE VS.REGULAR SCHEDULE	-0.243		0.24
OVERALL JOB DIMENSIONS			
O=28 HAVNG DECISION MAKNG, COMMUN,& SOCIAL RESP	1.359		0.37
O=29 PERFORMING SKILLED ACTIVITIES	0.003		0.32
O=30 BEING PHYS ACTIVE/RELATED ENVIRON CONDITION	3.498		0.43
O=31 OPERATING EQUIPMENT/VEHICLES	3.180		0.43
O=32 PROCESSING INFORMATION	2.121		0.45
	Z-SCORE:	-3 -2 -1 0 +1 +2 +3
	DESCRIP=	EXTREMELY VERY AVERAGE VERY EXTREMELY
	DIMS:	LOW LOW LOW HIGH HIGH

THE DASHES (-) WHICH BRACKET THE X'S INDICATE THE STANDARD ERROR OF MEASUREMENT.
THE O INDICATES THAT THE JOB DIMENSION SCORE EXCEEDS THE GRAPH LIMITS.

PAQ NUMBER = 701514
ORGANIZATION =
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 4/17/73
ANALYST(S) =
NUMBER OF ANALYSTS = 3

DATA DERIVED FROM THE POSITION ANALYSIS QUESTIONNAIRE (PAQ)

ITEM CHECK = ALL PAQ ITEMS WERE COMPLETED

SPECIAL ITEMS = THE FOLLOWING ITEMS MAY PROVIDE HELPFUL INFORMATION

ITEM	MEANING OF ITEM	SCORE	MEANING OF SCORE
20.	NEAR VISUAL DIFFERENTIATION	4.0	CONSIDERABLE DETAIL
22.	DEPTH PERCEPTION (IMPORTANCE)	4.3	HIGH IMPORTANCE
23.	COLOR PERCEPTION (IMPORTANCE)	3.0	AVERAGE IMPORTANCE
46.	EDUCATION (LEVEL OR EQUIV)	2.0	HGH SCHOOL DIPLOMA
47.	JOB-RELATED EXPERIENCE	1.3	LESS THAN 1 MONTH
48.	TRAINING (TIME TO LEARN JOB)	3.3	6 MONTHS TO 1 YEAR
49.	USING MATHEMATICS (LEVEL)	3.3	INTERMEDIATE
87.	LEVEL OF PHYSICAL EXERTION	4.0	HEAVY
92.	KNEELING/STOOPING (TIME)	1.7	BTWN 1/10 AND 1/3
128.	SUPRVIS OF NON-SUPERVISRY PERS	3.7	9 TO 12 WORKERS
129.	DIRECTION OF SUPERVISORY PERS	2.7	6 TO 8 SUP PERS
130.	TOTL NUM OF PERS FOR WHM RESP	2.7	51 TO 250 WORKERS
134.	SUPERVISION RECEIVED	1.7	GENERAL SUPERVISN

PREDICTED VALUES = MEAN TEST SCORE, STD. DEV. OF TEST SCORES, VALIDITY COEF., USE IN SELECTION, CUTTING SCORE.

NAME OF TEST	PRED. MEAN TEST SCORE	STD ERROR OF EST.	PRED. STD. DEV. OF TEST SCORES	STD ERROR OF EST.	PRED. VALID. COEF.	STD ERR OF EST.	PRED. USE IN SELECTION	STD ERR OF EST.	PRED. CUTTING SCORE
G=INTELLIGENCE	109.90	8.11	14.95	1.66	0.46	0.14	1.38	0.40	95
V=VERBAL APTITUDE	104.70	7.03	13.94	1.80	0.29	0.15	0.56	0.36	91
N=NUMERICAL APT.	104.17	8.40	16.26	1.78	0.30	0.13	1.01	0.43	88
S=SPATIAL APTITUDE	107.60	7.85	14.61	1.72	0.13	0.13	0.36	0.36	
P=FORM PERCEPTION	99.00	8.82	15.70	1.89	0.29	0.13	-0.22	0.37	
Q=CLERICAL PERCEPT	101.36	8.21	12.98	1.29	0.28	0.13	0.43	0.39	
K=MOTOR COORDINAT	99.31	7.09	17.27	1.97	0.18	0.12	0.29	0.39	
F=FINGER DEXTERITY	95.25	7.19	18.61	1.83	0.20	0.12	0.16	0.36	
M=MANUAL DEXTERITY	99.51	6.89	22.36	2.36	0.13	0.14	0.03	0.40	

JOB EVALUATION = PREDICTED JOB EVALUATION POINTS = 989.57 STANDARD ERROR OF ESTIMATE = 200.00

WARNING = THE JOB EVALUATION PREDICTIONS SHOULD BE INTERPRETED WITH CAUTION. SEE THE PAQ USER'S MANUAL AND THE TECHNICAL MANUAL.

PAQ NUMBER = 701510
ORGANIZATION
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 4/17/73
ANALYST(S) =
NUMBER OF ANALYSTS = 3

JOB PROFILE (DIMENSION SCORES PLOTTED BY PERCENTILE, Z-SCORE, DESCRIPTION)

DIVISION JOB DIMENSIONS	MAN SCORE	PERCENTILE .1 1 5 10 20 30 40 50 60 70 80 90 95 99 99.9	STD. ERR OF MEAS
A -1 MATCHING DEVICES/MATERIALS FOR INFORMATION	0.932		0.52
A- 2 INTERPRETING WHAT IS HEARD OR SEEN	2.181		0.48
A- 3 USING DATA ORIGINATING WITH PEOPLE	1.471		0.46
A- 4 WATCHING THINGS FROM A DISTANCE	1.641		0.44
A- 5 EVALUATING INFORMATION FROM THINGS	0.863		0.61
A- 6 BEING AWARE OF ENVIRONMENTAL CONDITIONS	2.535		0.74
A- 7 BEING AWARE OF BODY MOVEMENT AND BALANCE	3.771		0.96
M- 8 MAKING DECISIONS	0.615		0.56
M- 9 PROCESSING INFORMATION	1.085		0.62
C-10 CONTROLLING MACHINES/PROCESSES	0.283		0.58
C-11 USING HANDS AND ARMS TO CONTROL/MODIFY	0.983		0.62
C-12 USING FEET/HANDS TO OPERATE EQUIP/VEHICLES	3.502		0.42
C-13 PERFORMING ACTIVITIES REQUIRING GEN BODY MVMT	2.176		0.56
C-14 USING HANDS & ARMS TO MOVE/POSITION THINGS	-0.173		0.57
C-15 USING FINGERS VS GENERAL BODY MOVEMENT	-0.490		0.42
C-16 PERFORMING SKILLED/TECHNICAL ACTIVITIES	1.632		0.44
O-17 COMMUNICATING JUDGEMENTS, DECISIONS, INFORM	1.641		0.47
O-18 EXCHANGING JOB-RELATED INFORMATION	1.082		1.03
O-19 PERFORMING STAFF/RELATED ACTIVITIES	-0.726		1.00
O-20 CONTACTING SUPERVISORS OR SUBORDINATES	0.932		0.58
O-21 DEALING WITH THE PUBLIC	3.816		0.80
E-22 BEING IN A HAZARDOUS/UNPLEASANT ENVIRONMENT	3.102		0.42
F-23 ENGAGING IN PERSONALLY DEMANDING SITUATIONS	2.251		0.44
F-24 ENGAGING IN BUSINESSLIKE WORK SITUATIONS	0.056		0.32
F-25 BEING ALERT TO DETAIL/CHANGING CONDITIONS	1.043		0.50
F-26 PERFORMING UNSTRUCTURED VS STRUCTURED WORK	-1.285		0.46
F-27 WORKING ON A VARIABLE VS REGULAR SCHEDULE	-0.581		0.24
OVERALL JOB DIMENSIONS			
O-28 HAVING DECISION MAKING, COMMUN, & SOCIAL RESP	1.970		0.37
O-29 PERFORMING SKILLED ACTIVITIES	0.754		0.32
O-30 BEING PHYS ACTIVE/RELATED ENVIRON CONDITION	3.363		0.43
O-31 OPERATING EQUIPMENT/VEHICLES	2.963		0.43
O-32 PROCESSING INFORMATION	1.211		0.45
Z-SCORE		-3 -2 -1 0 +1 +2 +3	
DESCRIP-		EXTREMELY VERY LOW AVERAGE HIGH VERY EXTREMELY	

THE DASHES (-) WHICH BRACKET THE X'S INDICATE THE STANDARD ERROR OF MEASUREMENT.
THE 0 INDICATES THAT THE JOB DIMENSION SCORE EXCEEDS THE GRAPH LIMITS.

PAQ NUMBER = 701505
ORGANIZATION
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 8/17/78
ANALYST(S) =
NUMBER OF ANALYSTS = 3

DATA DERIVED FROM THE POSITION ANALYSIS QUESTIONNAIRE (PAQ)

ITEM CHECK = ALL PAQ ITEMS WERE COMPLETED

SPECIAL ITEMS = THE FOLLOWING ITEMS MAY PROVIDE HELPFUL INFORMATION

ITEM	MEANING OF ITEM	SCORE	MEANING OF SCORE
20.	NEAR VISUAL DIFFERENTIATION	3.7	CONSIDERABLE DETAIL
22.	DEPTH PERCEPTION (IMPORTANCE)	4.7	EXTREME IMPORTANCE
23.	COLOR PERCEPTION (IMPORTANCE)	4.3	HIGH IMPORTANCE
46.	EDUCATION (LEVEL OR EQUIV)	2.0	HGH SCHOOL DIPLOMA
47.	JOB-RELATED EXPERIENCE	1.7	1 MON TO 12 MONS
48.	TRAINING (TIME TO LEARN JOB)	1.7	30 DAYS TO 6 MONS
49.	USING MATHEMATICS (LEVEL)	3.3	INTERMEDIATE
87.	LEVEL OF PHYSICAL EXERTION	5.0	VERY HEAVY
92.	KNEELING/STOOPING (TIME)	2.0	BTWN 1/10 AND 1/3
128.	SUPRVIS OF NON-SUPRVISRY PERS	2.7	6 TO 8 WORKERS
129.	DIRECTION OF SUPERVISORY PERS	1.0	1 OR 2 SUP PERS
130.	TOTL NUM OF PERS FOR WHM RESP	0.7	1 TO 10 WORKERS
134.	SUPERVISION RECEIVED	3.0	GENERAL DIRECTION
143.	NOISE INTENSITY	3.7	LOUD

PREDICTED VALUES = MEAN TEST SCORE, STD. DEV. OF TEST SCORES, VALIDITY COEF., USE IN SELECTION, CUTTING SCORE.

NAME OF TEST	PRED. MEAN TEST SCORE	STD ERROR OF EST.	PRED. STD. DEV. OF TEST SCORES	STD ERROR OF EST.	PRED. VALID. COEF.	STD ERR OF EST.	PRED. USE IN SELECTION	STD ERR OF EST.	PRED. CUTTING SCORE
G=INTELLIGENCE	107.35	8.11	13.75	1.66	0.19	0.14	1.05	0.40	94
V=VERBAL APTITUDE	96.70	7.03	13.74	1.80	0.30	0.15	0.67	0.36	83
N=NUMERICAL APT.	102.26	8.40	16.17	1.78	0.17	0.13	1.00	0.43	86
S=SPATIAL APTITUDE	105.57	7.83	15.30	1.72	0.14	0.13	0.18	0.36	
P=FORM PERCEPTION	92.58	8.82	15.32	1.89	0.26	0.13	-0.09	0.37	
Q=CLERICAL PERCEPT	95.76	8.21	13.07	1.29	0.06	0.13	0.05	0.39	
K=MOTOR COORDINAT	94.10	7.09	17.56	1.97	0.15	0.12	0.39	0.39	
F=FINGER DEXTERITY	88.06	7.19	16.84	1.83	0.16	0.12	0.19	0.36	
M=MANUAL DEXTERITY	94.60	6.89	22.16	2.36	0.08	0.14	0.20	0.40	

JOB EVALUATION = PREDICTED JOB EVALUATION POINTS = 894.40 STANDARD ERROR OF ESTIMATE = 180.00

WARNING = THE JOB EVALUATION PREDICTIONS SHOULD BE INTERPRETED WITH CAUTION, SEE THE PAQ USER'S MANUAL AND THE TECHNICAL MANUAL.

(A) N WICH = PUBSD
ORGANIZATION
JOB TITLE = FIREFIGHTER
DEPARTMENT/UNIT =
DATE = 9/1/73
ANALYST(S) =
NUMBER OF ANALYSTS = 3

JOB PROFILE (DIMENSION SCORES PLOTTED BY PERCENTILE, Z-SCORE, DESCRIPTION)

DIVISION JOB DIMENSIONS	DMN SCORE	PERCENTILE .1 1 5 10 20 30 40 50 60 70 80 90 95 98 99.9	STD. ERR OF MEAS
A =1 MATCHING DEVICES/MATERIALS FOR INFORMATION	-1.388		0.52
A= 2 INTERPRETING WHAT IS HEARD OR SEEN	2.996		0.48
A= 3 USING DATA ORIGINATING WITH PEOPLE	0.528		0.46
A= 4 WATCHING THINGS FROM A DISTANCE	0.755		0.44
A= 5 EVALUATING INFORMATION FROM THINGS	0.709		0.61
A= 6 BEING AWARE OF ENVIRONMENTAL CONDITIONS	3.510		0.74
A= 7 BEING AWARE OF BODY MOVEMENT AND BALANCE	4.062		0.94
A= 8 MAKING DECISIONS	0.348		0.56
A= 9 PROCESSING INFORMATION	-0.019		0.62
C=10 CONTROLLING MACHINES/PROCESSES	-0.019		0.58
C=11 USING HANDS AND ARMS TO CONTROL/MODIFY	0.654		0.82
C=12 USING FEET/HANDS TO OPERATE EQUIP/VEHICLES	3.973		0.42
C=13 PERFORMING ACTIVITIES REQUIRING GEN BODY MOVE	3.821		0.56
C=14 USING HANDS & ARMS TO MOVE/POSITION THINGS	-1.497		0.57
C=15 USING FINGERS VS GENERAL BODY MOVEMENT	-0.246		0.42
C=16 PERFORMING SKILLED/TECHNICAL ACTIVITIES	0.139		0.46
D=17 COMMUNICATING JUDGEMENTS, DECISIONS, INFORM	1.130		0.47
D=18 EXCHANGING JOB-RELATED INFORMATION	-0.587		1.03
D=19 PERFORMING STAFF/RELATED ACTIVITIES	1.058		1.00
D=20 CONTACTING SUPERVISOR OR SUBORDINATES	0.890		0.58
D=21 DEALING WITH THE PUBLIC	3.114		0.60
E=22 BEING IN A HAZARDOUS/UNPLEASANT ENVIRONMENT	3.542		0.42
E=23 ENGAGING IN PERSONALLY DEMANDING SITUATIONS	2.699		0.44
E=24 ENGAGING IN BUSINESSLIKE WORK SITUATIONS	-0.441		0.32
F=25 BEING ALERT TO DETAIL/CHANGING CONDITIONS	2.113		0.50
F=26 PERFORMING UNSTRUCTURED VS STRUCTURED WORK	-1.154		0.46
F=27 WORKING ON A VARIABLE VS REGULAR SCHEDULE	-0.504		0.24
OVERALL JOB DIMENSIONS			
O=28 HAVNG DECISION MAKNG, COMMUN, & SOCIAL RESP	1.768		0.37
O=29 PERFORMING SKILLED ACTIVITIES	-0.089		0.32
O=30 BEING PHYS ACTIVE/RELATED ENVIRON CONDITION	3.646		0.43
O=31 OPERATING EQUIPMENT/VEHICLES	3.325		0.43
O=32 PROCESSING INFORMATION	-0.259		0.45
Z-SCORE:		-3 -2 -1 0 +1 +2 +3	
DESCRIP:		EXTREMELY VERY VERY EXTREMELY	
(100):		LOW LOW LOW AVERAGE HIGH HIGH HIGH	

THE DASHES (-) WHICH BRACKET THE X'S INDICATE THE STANDARD ERROR OF MEASUREMENT.
THE U INDICATES THAT THE JOB DIMENSION SCORE EXCEEDS THE GRAPH LIMITS.

APPENDIX II

CRITICAL INCIDENT CATEGORY DESCRIPTIONS
FIREFIGHTER

A. SPECIALIZED JOB KNOWLEDGE:

Has a good knowledge of firefighting equipment and how to use it; knows firefighting techniques and tactics; knows the assigned territory; knows proper first-aid and rescue techniques; knows and can perform job duties requiring technical skills such as tying knots, filling out reports, driving and positioning equipment; knows and attends to relevant details of job performance in certain situational conditions; has the necessary knowledge to perform his duties in a thorough and precise manner.

B. INTEREST IN LEARNING:

Conscientiously participates in training sessions and courses; continuously strives to increase his knowledge of territories, firefighting techniques and equipment; utilizes suggestions for self-improvement; demonstrates additional interest in learning by: attending unrequired courses and seminars, bringing in articles and materials related to firefighting; accepts constructive criticism.

C. HELPING OTHERS LEARN:

Takes an interest in helping new recruits learn: firefighting techniques, territories, equipment, rules and regulations; encourages others to increase their knowledge of firefighting skills; helps and guides new recruits.

D. RELATIONSHIP WITH PEERS:

Is even-tempered and has a pleasing personality; instills confidence and shows trust in others; is sensitive and understanding in his relationships with others; is fair and honest in his dealings with other firefighters; is not overly critical of fellow firefighters and superiors; gets along well with fellow firefighters; is considerate of others' feelings.

E. RELATIONSHIP WITH THE PUBLIC:

Is courteous and polite; presents a good public image; does not use rude or abusive language in the presence of the public; helps the public in any way he can.

F. WILLINGNESS AND EAGERNESS TO DO THEIR PART OF THE WORK AT THE STATION:

Carries out orders promptly and does not complain about assigned duties at the station; does not try to avoid routine work and eagerly assists others in maintenance operations; is willing to do their share of the hardest and dirtiest work; works as a team member and helps others without being asked to do so.

G. WILLINGNESS AND EAGERNESS TO DO THEIR PART OF THE WORK AT A FIRE:

Carries out orders promptly and does not complain about assigned duties at the scene of a fire; does not try to avoid work at the scene of the fire and eagerly assists in cleanup operations; works as a team member and is responsible in fulfilling his duties at the scene of a fire.

H. RESPECT FOR PROPERTY AND EQUIPMENT:

Shows concern for personal effects of fire victims; shows concern for equipment by: keeping equipment clean and operative, storing and utilizing equipment in the prescribed manner, not abusing equipment, insuring that equipment is not left at the fire scene, not discarding damaged equipment that could possibly be repaired.

I. PROFESSIONALISM:

Demonstrates reliability by reporting to work on time and in a suitable condition to perform his duties; takes pride in his personal appearance and hygiene; seeks self-satisfaction in the job by taking pride in his performance; maintains respectability by exhibiting acceptable moral standards; conforms to rules and regulations.

J. REMAINS CALM IN PERSONALLY DEMANDING SITUATIONS:

Remains calm, doesn't panic or get confused and, consequently, maintains his ability to make correct and rational decisions in stressful situations; controls emotions, doesn't freeze up at the scene of a fire or during rescue and first-aid operations; exhibits a high degree of self-confidence and accepts responsibility in tense situations.

K. ABILITY TO PERFORM PHYSICALLY DEMANDING TASKS:

Is capable of performing a variety of job duties that require a high degree of physical strength and agility, such as: climbing stairs, ladders, and ropes while carrying excess weight, running short distances, gaining forced entry, controlling hoses and nozzles while on a ladder or on the ground, driving large fire vehicles.

L. ABILITY TO FOLLOW ORDERS:

Is capable of remembering and following set procedures, rules, and regulations; understands and correctly carries out both verbal and written commands, orders, etc.; understands and correctly follows orders given at the scene of a fire.

M. RESPONSIBILITY FOR THE SAFETY OF OTHERS:

Exhibits behaviors and attitudes that reflect his concern for the safety of fellow workers, such as: working as a team member to insure the safety of others, putting safety first by not taking shortcuts in the performance of proven techniques, attending to the safety of others while fighting a fire, driving a fire vehicle in a safe manner.

N. ABILITY TO MAKE CORRECT DECISIONS:

Is observant to changing situational conditions; displays good judgment in analyzing situations and determining appropriate action; quickly determines appropriate firefighting techniques and selects the proper equipment; makes correct decisions as a result of properly integrating job knowledge with situational conditions.

O. ABILITY TO WORK EFFECTIVELY IN A HAZARDOUS, UNPLEASANT ENVIRONMENT:

Performs his duty in hazardous situations in a manner that reflects bravery and courage; is not reluctant to enter dangerous situations and does not hesitate when performing his duties in dangerous situations; is willing to and capable of withstanding smoke, heat, cold, etc.; is not afraid of heights.

APPENDIX III

FORT WORTH FIREFIGHTER PERFORMANCE DIMENSIONS

EMERGENCY WORK

1. Knowledge and use of apparatus, tools and equipment.
2. Cooperation with members of his company.
3. Awareness of the position and tasks of every member of the team.
4. Demonstrated knowledge of auxiliary extinguishment aids including sprinklers, standpipes, etc., in first and multiple alarm territory.
5. Indication of competitive team spirit in relation to other companies.
6. Demonstrated knowledge of streets, hydrants, and buildings in first alarm and multiple alarm territory.
7. Dependability in producing consistently good results with a minimum of wasted effort.
8. Willingness to accept authority in receiving and executing orders promptly.
9. Demonstration of good public relations in general behavior and speech at the emergency scene.
10. Recognition of emergency problems and readiness to adjust strategies in view of changing conditions.
11. Utilization of safety equipment and clothing and observation of standard safety procedures.
12. Making logical decisions based on available information and the use of common sense.

13. Alertness to hazardous conditions and taking precautions to prevent accidents to himself and others.
14. Skill in using standard techniques of fire suppression to produce desired results.
15. Skill in using standard techniques in emergencies other than fire suppression to produce desired results.
16. Indication of physical stamina (toughness) by enduring hardships and heavy work loads.
17. Aggressiveness in attacking a fire or emergency situation as opposed to holding back.
18. Indication of courage by encountering danger and physical abuse knowingly and willingly.

SUPPORT FUNCTIONS

1. Promptness in beginning scheduled work, watch duty, drills and other meetings.
2. Reflection of dependability and consistency in the attendence record.
3. Maintenance of quarters in a clean and orderly fashion in preparation for the oncoming shift.
4. Maintenance of protective gear and clothing in a good state of repair.
5. Maintenance of tools and apparatus after use for proper storage and operation according to specifications and Department policy.
6. Observation of company rules and regulations during non-emergency operations.
7. Proper maintenance and utilization of reports and records.

8. Participation during overhaul operations.
9. Demonstration of knowledge and application of standard techniques during participation in basic drills.
10. Recognition of potential fire hazards and possible extinguishment problems while on inspections.
11. Attention and receptivity to orders and instructions in drills, training and schools.
12. Indication of good public relations during inspections by describing and explaining code provisions and purposes.
13. Preparation for the future by studying to improve knowledge of procedures, regulations and other aspects important to fireman effectiveness.
14. Proper interpretation and application of city codes during inspections.

SOCIAL AND PERSONAL ASPECTS

1. Demonstrating an ability to get along well with the general public.
2. Showing a willingness to get along with other members of the department.
3. Indication of a willingness to get along with superiors.
4. Demonstration of favorable attitudes toward the Department, reflecting positive identification as a member of the fire service.
5. Having personal hygiene habits agreeable to station members with whom he lives.
6. Personal appearance reflecting an adherence to Department regulations.

7. Off-duty behavior reflecting favorably on the fire service in accord with civil service policy.
8. Demonstrated ability to work and live as a considerate member of the company.

APPENDIX IV

Person you are rating

FIREFIGHTER
Job Classification

Your name

Jurisdiction

PERFORMANCE EVALUATION CHECKLIST

No	Don't Know	Yes		
N	DK	Y	1.	Avoids dangerous horseplay.
N	DK	Y	2.	Corrects potential safety hazards around the station.
N	DK	Y	3.	Always looks out for the safety of his fellow workers.
N	DK	Y	4.	Has an excellent safety record.
N	DK	Y	5.	Always keeps safety in mind.
N	DK	Y	6.	Is outstanding in his relationship with the public.
N	DK	Y	7.	Recognizes the importance of presenting a good public image of the fire department.
N	DK	Y	8.	Actively participates in community fire prevention programs.
N	DK	Y	9.	Uses tact when dealing with the public at the scene of a fire.
N	DK	Y	10.	Constantly strives to improve the public's image of the fire service.
N	DK	Y	11.	Is quick to react when a decision is required.
N	DK	Y	12.	Is very observant of situational conditions when making a decision.
N	DK	Y	13.	Always selects the proper kind and amount of equipment necessary to accomplish rescue operations.
N	DK	Y	14.	Always seems to do the right thing at the fire scene.
N	DK	Y	15.	Always selects the proper kind and amount of equipment necessary to accomplish ventilation.
N	DK	Y	16.	Has never been known to "freeze-up" while fighting a fire or during rescue operations.
N	DK	Y	17.	Exhibits a high degree of self-confidence.
N	DK	Y	18.	If you had to enter a stressful situation and your life would be in danger, this man would be your first choice to go with you.
N	DK	Y	19.	Is always level-headed in an emergency.
N	DK	Y	20.	Serves as a steadying influence for other firefighters or members of the public at the scene of a fire.
N	DK	Y	21.	Double-checks to insure that equipment is not left at the fire scene.
N	DK	Y	22.	Always stores hoses, nozzles, ropes, etc. in the specified manner.
N	DK	Y	23.	Generally does not abuse firefighting equipment.
N	DK	Y	24.	Goes out of his way to protect the personal property of fire victims.
N	DK	Y	25.	Does not waste cleaning agents/utensils when performing his duties.
N	DK	Y	26.	Can transport and place a 24 foot extension ladder with minor difficulty.
N	DK	Y	27.	This man would be one of your first choices for a difficult physical assignment.
N	DK	Y	28.	Is capable of descending a ladder while carrying a 150 pound unconscious victim.
N	DK	Y	29.	Is physically agile and can crawl/climb in and among fallen debris in search of fire victims.
N	DK	Y	30.	Has the physical strength to lift heavy objects which trap fire victims.

N	DK	Y	31.	Always reports to work on time.
N	DK	Y	32.	Is proud to be a firefighter.
N	DK	Y	33.	Takes pride in his personal appearance.
N	DK	Y	34.	Conforms to rules and regulations.
N	DK	Y	35.	Always conducts himself in a professional manner while on duty.
N	DK	Y	36.	Continuously strives to increase his knowledge of territories.
N	DK	Y	37.	Shows extreme interest in learning the material covered in training sessions and courses.
N	DK	Y	38.	Actively participates in training sessions.
N	DK	Y	39.	Makes use of constructive suggestions to improve his performance.
N	DK	Y	40.	Brings in outside articles and materials related to firefighting.
N	DK	Y	41.	Always executes orders in their proper sequence.
N	DK	Y	42.	Always remembers and follows orders correctly.
N	DK	Y	43.	Needs instructions only once.
N	DK	Y	44.	Always correctly follows specific instructions.
N	DK	Y	45.	Always remembers and follows set procedures correctly.
N	DK	Y	46.	Regularly, on own initiative, assists other firefighters by sharing information, explaining the best, most effective way of doing things, etc.
N	DK	Y	47.	Tutors others who have trouble learning the required material.
N	DK	Y	48.	Is never too busy to answer questions related to firefighting.
N	DK	Y	49.	Helps others learn.
N	DK	Y	50.	Offers constructive suggestions to others.
N	DK	Y	51.	Thoroughly knows the assigned territory; knows the shortest routes to all locations.
N	DK	Y	52.	Has an excellent knowledge of all equipment and its uses.
N	DK	Y	53.	Always detects and reports defective equipment.
N	DK	Y	54.	Always uses proper ventilation techniques.
N	DK	Y	55.	Demonstrates an excellent knowledge of first aid.
N	DK	Y	56.	Always performs his routine work around the station.
N	DK	Y	57.	Always does a thorough and complete job when performing maintenance work around the station.
N	DK	Y	58.	Does station work without complaining.
N	DK	Y	59.	Does his share of the work in the kitchen.
N	DK	Y	60.	Works well as a team member around the station.
N	DK	Y	61.	Works well as a team member at the scene of a fire.
N	DK	Y	62.	Always carries out orders promptly and thoroughly at the scene of a fire.
N	DK	Y	63.	Always does a thorough and complete job at the scene of a fire.
N	DK	Y	64.	Does his share of the work at the scene of a fire.
N	DK	Y	65.	Never "loafs around" at the fire scene.
N	DK	Y	66.	Treats fellow firefighters with fairness regardless of race; is not prejudiced.
N	DK	Y	67.	Rarely loses his temper.
N	DK	Y	68.	Is trusted by fellow workers.
N	DK	Y	69.	Is generally liked by fellow workers.
N	DK	Y	70.	Gets along well with fellow firefighters.
N	DK	Y	71.	Always enters and works effectively in dangerous situations.
N	DK	Y	72.	When necessary, withstands a good deal of smoke, heat, cold, etc even though others may drop out.
N	DK	Y	73.	Takes necessary personal risks to effectively perform his duty.
N	DK	Y	74.	Is not afraid of heights.
N	DK	Y	75.	Has performed unpleasant tasks such as placing charred bodies in disaster pouches.

APPENDIX V

NAME_____

JURISDICTION_____

TEST SCORE_____

FIREFIGHTER
JOB KNOWLEDGE TEST*

ARC

*This document is a product of the Atlanta Regional Commission "Test Validation Project" and is being used for research purposes only.

1. There is greatest possibility of a back-draft if upon arriving at a fire it is found that window panes are:

   A. relatively cool and such smoke as is escaping remains close to the ground.
   B. relatively cool and such smoke as is escaping rapidly.
   C. hot and such smoke as is escaping remains close to the ground.
   D. hot and such smoke as is escaping rises and sucks back in rapidly.

2. A cooper hose jacket is best used to:

   A. keep hose from freezing.
   B. place over small rupture.
   C. replace section of hose.
   D. connect pump to hydrant.

3. When confronted with a fire in an electrical sub station, you should:

   A. use large streams of water.
   B. protect exposures, notify power officials, and await their orders.
   C. use large amounts of foam from the hopper at once.

4. For every floor or every 12 1/2 feet of elevation, how many pounds should be allowed for back pressure?

   A. 5 pounds
   B. 10 pounds
   C. 15 pounds
   D. 25 pounds

5. As a result of complete conbustion, the principal product will be, in most cases:

   A. carbon dioxide
   B. carbonate
   C. carbon monoxide
   D. carbona

6. Of the following materials used in fire extinguishers the one that is the best conductor of electricity is:

   A. soda and acid
   B. carbon tetrachloride
   C. carbon dioxide
   D. dry chemical

7. The purpose of the double male and double female connection is:

   A. to replace a ruptured section of hose.
   B. used where treads are scarred.
   C. used to connect hose when two male or two female connections come together.
   D. used when making a mechanical from layout.

8. To lower a fifty foot ladder which has the ladder locks frozen, you would use the following equipment:

   A. ladder jacks and 3/4" rope.
   B. hose hoist and a 1/2" rope.
   C. hose hoist and a 3/4" rope.
   D. ladder boom.

9. One of the following which is the chief reason why a fog spray is frequently a more effective extinguishing agent than a solid stream, is that steam from a fog spray:

   A. penetrates more deeply.
   B. remains suspended in the air.
   C. tends to remain on the surface.
   D. presents a greater surface area.

10. When an entire attic is ablaze, the best approach is from:

   A. the side ventilators.
   B. the roof.
   C. an opening underneath the attic.
   D. the outside of the building.

11. The one of the following expressions is used to characterize the conditions which exists when two pumpers are hooked together at the hydrant is:

   A. in conjunction.
   B. in relay.
   C. in connection.
   D. in tandem.

12. The friction loss used for standpipe system is:

   _____A. 75 lbs. _____C. 125 lbs.
   _____B. 100 lbs. _____D. 150 lbs.

13. A Booster Foam Gun would be used on:

   _____A. Class "D" fire _____C. Class "A" fire
   _____B. Class "B" fire _____D. Class "C" fire

14. The best way to tighten hose connections, when they are under water pressure is:

_____A. with hands.
_____B. Stillson wrenches.
_____C. Cooper hose jacket.
_____D. Spanner wrencehes.

15. When working from a ladder, a fireman should:

_____A. lay in close to the building.
_____B. lock his arm around the beam on the side he is working.
_____C. make use of leg lock.
_____D. never turn loose the ladder with both hands.

16. Halon is best to use on electric fires because:

_____A. it is fast cooling agent, and will not conduct electricity.
_____B. it cools the motor slowly, thus protecting the generator.
_____C. it leaves no mess to clean up.
_____D. it is a non-conductor of electricity, and leaves no residue.

17. A Class "A" fire is:

_____A. Gasoline, Naphtha, kerosene, and paint thinners.
_____B. Wood, debri, excelsior, rags, and paper.
_____C. Electrical motors and gas motors.
_____D. Electrical motors, automobiles, tractors.

18. The most common type of pump found in fire apparatus is the:

_____A. Piston
_____B. Centrifugal
_____C. Reciprocating
_____D. Rotary

19. Pre-connected lines are usually most effective:

A. for covering men who are handling larger lines at a hot and smokey fire.
B. for a quick, early attack on fires that have not gained much headway.
C. when they follow the 1" booster lines into upper stories of a building.
D. when the fire involves large open spaces.

20. The principle of the fog nozzle is based chiefly upon the fact that:

A. Water absorbs heat less quickly than air.
B. Water absorbs a great amount of heat when it evaporates.
C. A relatively small amount of heat will raise the temperature of water to a considerable degree.
D. Even a relatively large amount of heat will have but little effect on the temperature of air.
E. Water spray generally absorbs less heat than a solid stream.

21. The high pilling of materials under sprinkler heads is undesirable because:

A. sprinklers will fail to operate.
B. water cannot reach the seat of the fire.
C. it would delay installing new heads for those activated.
D. materials would be subject to heavy water damage.

22. Explosions of vapor-air mixtures inside tanks containing flammable liquids are most frequent when the tank is:

A. Full.
B. Has just been emptied.
C. Is being filled.

23. Of the following conditions, the one which is most favorable for an explosion of flammable vapors is:

A. high humidity.
B. high diffusion rate.
C. low ignition temperature.
D. low volatility.
E. much air movement.

24. Of the following flame colors, the one which indicates the highest temperature is:

A. orange-red.
B. orange-yellow.
C. light-red.
D. yellow-white.

25. Partitions for enclosures, such as stairways or elevators, should be for at least:

____ A. 15 minutes fire resistance.
____ B. 1 hour fire resistance.
____ C. 4 hours fire resistance.

26. Operating a centrifugal pump and the pump is working in the parallel position you are pumping-

A. Pressure.
B. Series.
C. Volume.

27. The thumb rule to determine the distance to place the butt of a ladder from the base of the building:

A. Divide the length of the ladder by 5 and add 2 feet.
B. Divide the height the ladder is to be raised by 4 and add 2 feet.
C. Divide the height the ladder is to be raised by 5 and multiply by 2.

28. The number of men required to raise a fifty foot ladder (metal ladder) is:

A. 4
B. 7
C. 6
D. 8

29. An engine is pumping through eight sections of 2 1/2 inch diameter hose, equipped with a 1 1/4 inch tip; the pressure at the pump being 150 pounds, and the discharging of water is approximately 328 gallons per minute. (A) what is the friction loss? (B) what is the tip pressure?

_____A. 50 pounds friction loss and 100 pounds tip pressure.
_____B. 100 pounds friction loss and 50 pounds tip pressure.
_____C. 75 pounds friction loss and 75 pounds tip pressure.

30. What type sprinkler system is more suitable for use in lumber yards?

_____A. Wet
_____B. Dry
_____C. Sypho

31. To extinguish a class "A" fire you would use:

_____A. Carbon Dioxide Entinguisher.
_____B. Dry powder Extinguisher.
_____C. Foam Extinguisher.
_____D. Soda-acid Extinguisher.

32. To extinguish a cooking oil fire what extinguishing agent would you use?

_____A. Soda-acid.
_____B. Foam.
_____C. Carbon dioxide.

33. What should a fireman do before using a forcible entry tool on a door?

_____A. Break the glass.
_____B. Place an axe at the door jamb.
_____C. Remove pins from the door.
_____D. Check the door to see if it is locked.

34. L.P. Gases must be:

_____A. Deodorized before using.
_____B. Odorized to aid in detecting leaks.
_____C. Odorized to decrease corrosion.
_____D. Odorized to help control vaporization.

35. The knot used to hoist a loaded line into any height would be:

_____A. round turn and two half hitches.
_____B. clove hitch and two half hitches.
_____C. bowline and two half hitches.

36. To prevent manila ropes from becoming frayed or unraveled, the best method to use would be:

_____A. tape ends.
_____B. tie off with a good secure knot.
_____C. back-splice or thread wrap and wax dip.

37. Hose not drained properly, -- water left in the hose for a length of time, will sometimes cause a weak solution of:

_____A. hydrochloric acid to form.
_____B. sulphuric acid to form.
_____C. chlorine and sulphur to form.

38. When operating pumpers in a relay hook-up, the larger capacity pumper should be positioned at the

_____A. scene of the fire.
_____B. water supply.
_____C. middle of hose line, or lines, with smaller pumper on either side.

39. What is generally accepted as the least destructive method of forcible entry?

_____A. Break down a door.
_____B. Break a lock.
_____C. Break an inexpensive window.

40. When using of an auger for drilling a hole, you should always:

_____A. drill through the supporting beams; this makes the hole stronger.
_____B. open hole in middle of aisle; this makes it easier to find.
_____C. watch out for valuable stocks on floor below and keep auger away from supporting beams.

41. For window ventilation, windows should be set as:

_____A. 1/2 open and 1/2 closed -- this will cause air to suck in and force smoke and heat outward.
_____B. lower top sash 2/3 and raise bottom sash 1/3 -- air will be drawn in at bottom and force smoke out at top.
_____C. lower bottom sash 1/2 and raise top sash 2/3 -- this will force air into room and press heat and smoke outwardly.

42. Flammable liquids with a flash point below 100°F. should be extinguished with:

_____A. water fog and deluge stream.
_____B. carbon dioxide and straight streams of water.
_____C. carbon dioxide, dry chemical, or foam.

43. Attic fires are best fought by:

_____A. opening up of roof and placing cellar pipes or streams over fire.
_____B. stretching hose line up stairway to top floor, gaining entrance to attic by scuttle hole or trap door, using fog streams if fire has not broken through roof.
_____C. stretching hose lines up stairway to top floor -- open up by pulling entire ceiling in one room only -- use straight streams.

44. What should a fireman do before using a forcible entry tool on a door?

_____A. break the glass.
_____B. place an axe in the door jamb.
_____C. remove pins from door.
_____D. check the door first to see if it is locked.

45. Proper ventilation of a building during a fire reduces the:

_____A. chance of a fire mushrooming.
_____B. creates more salvage work.
_____C. makes a firefighting easier, but causes excessive fire damages.

46. Salvage begins:

_____A. upon orders of a chief officer.
_____B. upon arrival, by using the right size nozzle tip on hose lines, and proper placing of salvage covers.
_____C. after the fire has been extinguished.

47. When ventilating using the horizontal method, (windows on two sides of a building), how should windows be positioned for best results?

_____A. windows opened from bottom half on both sides of building.
_____B. windows opened from top half on both sides of building.
_____C. windows opened from top on one side of building, opened from the bottom on other side of building.

48. When ventilating from the top of a building, (vertical), to obtain best results:

_____A. make a four-by-four opening in roof only.
_____B. open the roof and break through the ceiling for best results.
_____C. it is of no value to break through the ceiling below the opening of the roof.

49. Advantages of forced ventilation are:

_____A. it can move fire along with smoke and extend it to lateral areas.
_____B. under certain circumstances a blower fan can increase the possibility of a back-draft.
_____C. it should insure closer control of ventilation, supplement natural ventilation -- it may be used when other methods fail.

50. Friction loss means:

_____A. a part of the total pressure that is used to overcome static pressure in the pump.
_____B. that part of total pressure that is used to overcome friction.
_____C. that part of pressure that is recorded by petot gauge as it leaves the nozzle tips.

APPENDIX VI

OBJECTIVE PERFORMANCE TESTS

1. Knots and Ropes - Each firefighter was tested individually in the following manner:

   The subject, in full turnout gear, was blindfolded and given a four foot section of manila hemp rope. Each subject was required to tie the following seven knots for time while blindfolded:

   1) Bowline
   2) Square knot
   3) Round turn & two half hitches
   4) Bowline on a bight
   5) Clove hitch
   6) Double beckett
   7) Single beckett bend

   Any necessary props were provided. Each man received seven scores, since times were taken on each test knot. Order of presentation of the test knots was varied randomly by individual instructors.

2. One-Man Hose Lay - Each firefighter was tested individually in the following manner:

   Two (2) fifty foot (50 ft.) sections of 2-1/2 inch hose were rolled in coils and located on the tail board of a pumper positioned twenty-five feet (25 ft.) from the test hydrant. Each subject was dressed in full turn out gear. At a signal from the instructor, the stop-

watch was started and the firefighter began by removing the hydrant wrench from its storage compartment. He then proceeded to transport one section of 50 ft. 2-1/2 inch line from the pumper tailboard to the test hydrant. He then removed both 2-1/2 inch caps from the hydrant outlets and placed the hydrant wrench on top of the hydrant. He next attached the 50 ft. section of 2-1/2 inch hose, already at the hydrant, to the hydrant outlet to which it was attached. Upon completion of this phase of the test he returned to the pumper tailboard obtaining the second 50 ft. section of 2-1/2 inch hose to the second 2-1/2 inch hydrant outlet and roll the hose straight out from the hydrant outlet to which it was attached. Upon completion of this phase of the test, he returned to the hydrant and placed his hand upon the hydrant wrench. At this point the instructor stopped his watch and recorded the elapsed time for the subject to accomplish the above task.

3. Spotting of Apparatus & Hook Up of Soft-Suction Supply Hose - (For Apparatus Operators Only) - Each fire apparatus operator was tested individually in the following manner:

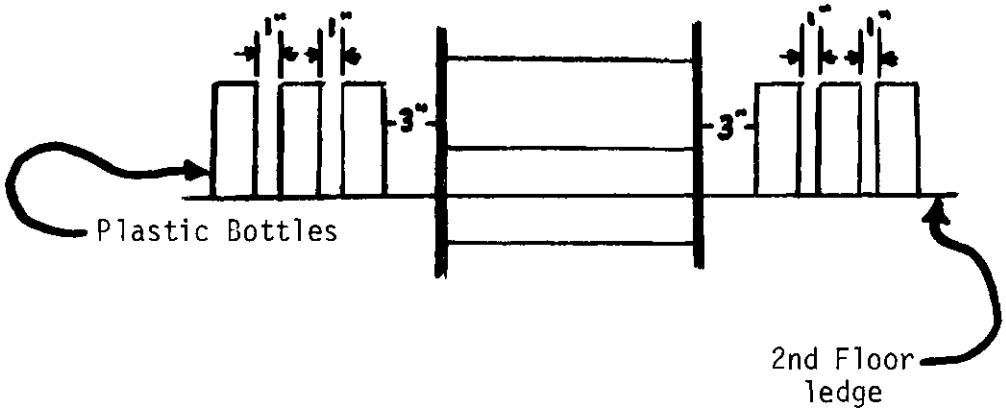
The subject was dressed in his helmet and work uniform and was seated at the wheel of his pumper vehicle. The vehicle was stopped with the engine off at a distance of 100 yards from the test hydrant. Then upon a signal from the instructor, (also riding in driver's compartment of the same vehicle), the subject started the engine of his vehicle and began his 300 ft. approach to the test hydrant. As he approached the hydrant, he spotted (positioned) his apparatus in

preparation of the catching of the hydrant. The subject then changed from road to pump gear. To accomplish this change, the motor was removed from the road transmission by releasing the clutch such that the gears stood idle during the change. The road transmission was then placed in the specified gear for pumping. The pump shifting lever was then changed from road to pump. Then the clutch was engaged and the hand brake was engaged. The subject then proceeded to climb out of the truck and chocked the wheels of the apparatus. Next, he removed the hydrant wrench from the tool compartment and placed it on the running board beside the steamer connection. Next, he removed the two (2) 2-1/2 inch intake caps (hand-tight) from the side of the pumper. He then removed two (2) 12 to 18 foot coiled sections of 2-1/2 inch hose from their storage compartment and made connections with these hose lines to the two 2-1/2 inch intakes on the side of the pumper. Then the subject proceeded to pick up the hydrant wrench and roll one section of the 2-1/2 hose to the hydrant. He then proceeded to remove the two (2) 2-1/2 inch caps (hand-tight) from the hydrant and hooked the 2-1/2 inch hose, already at the hydrant, to one of the two 2-1/2 inch hydrant outlets. Next he returned to the pumper and rolled the second section of 2-1/2 inch hose to the hydrant and hooked it to the remaining 2-1/2 hydrant outlet. The subject then turned on the hydrant, thus, getting water to the pumper. The instructor stopped his watch and recorded the elapsed time to accomplish the above task when the compound pressure gauge on the side of the pumper registered that water had arrived at the pumper and the subject had obtained his turnout coat and boots

from their storage compartment on the pumper and was dressed in full turnout gear.

4. One-Man Ladder Handling - Each firefighter was tested individually in the following manner:

The subject was in full turnout gear. A pumper was positioned 50 ft. away from a two-story building. At a signal from the instructor (stopwatch was started), the subject removed a 20-ft. straight aluminum ladder from the side of the pumper and transported it to the side of the two-story building. He then positioned the ladder between six (6) plastic bottles which had been placed along the ledge on the second floor roof in the following manner:



Following placement of the ladder between the bottles, the instructor gave a voice command "move", at which time the subject removed the ladder from its position between the bottles and moved the ladder, using a balanced transport technique, to the right to a point 20 ft. down the side of the building and again placed the ladder between the second set of bottles which were set up the same as the first set of

bottles. When the ladder was placed between the second set of bottles, a confederate stepped in to hold the bottom of the ladder and the subject proceeded to climb to the top of the ladder. When the subject touched the second floor ledge, the instructor stopped his watch and recorded the elapsed time to accomplish the above task and the number of bottles knocked off the ledge during the task.

5. Hand Traverse Across A 24 ft. Ladder - Each firefighter was tested individually in the following manner:
Each subject was dressed in full turnout gear. A 24 ft. ladder was bridged (suspended) eight to nine feet above the ground. Only a 20 ft. section of the ladder was used for test purposes. Subjects were required to support their own weight by grasping one rung of the ladder with both hands and then bending both legs at the knee. Subjects then proceeded to hand traverse as many rungs as possible across a 20 ft. section of the ladder. The subject's score on this test was recorded by the instructor as the number of ladder rungs traversed by the subject across the 20 ft. test section.

6. Handling of Scott Air Paks - Each firefighter was tested individually in the following manner:
Each subject was dressed in full turnout gear. A Scott air pak carrying case was placed at the feet of the subject. Upon a signal from the instructor, (stop watch is started), the subjects proceeded to open the carrying case. The air tank was then pulled from the case and positioned on the back of the subject with all the straps

fastened. The subject then proceeded to remove the air mask from inside the case and placed the mask on his face and adjusted it to assure the proper seal which he checked. Then the hose from the air mask was attached to the regulator and it was turned on. The instructor proceeded to stop the watch and record the elapsed time to accomplish the above task when all straps were fastened and the subject was wholly on the compressed air system.

7. Ladder Climb With Weight - Each subject was tested individually in the following manner:

The subject was in full turnout gear. A pumper was positioned 50 ft. away from a two-story building. At a signal from the instructor (stop watch was started), the subject removed a 20-ft. straight aluminum ladder from the side of the pumper and transported it to the side of the two-story building. The subject then positioned and raised the ladder at a point specified on the roof of the two-story building. He then returned to the pumper and obtained a spanner wrench and a 2-1/2 inch to 1-1/2 inch adapter from the storage compartment. He then proceeded to the tailboard of the pumper and obtained a 50-ft. section of 2-1/2 inch hose and a 2-1/2 inch fog nozzle. He then returned to the ladder which was previously placed at the side of the two-story building and climbed the ladder to the roof with another person holding the ladder. When the roof was reached, the subject climbed from the ladder onto the roof and then proceeded to attach the 2-1/2 inch to 1-1/2 inch adapter to the 1-1/2 inch gate valve lying 5 ft. from the edge of the roof. The subject

then proceeded to attach the 2-1/2 inch hose to the adapter at that point. The instructor proceeded to stop the watch and recorded the elapsed time to accomplish the above task.

8. Ladder Descent With Weight - Each subject was tested individually in the following manner:

The subject was in full turnout gear. A pumper was positioned 50 ft. away from a two-story building. At a signal from the instructor (stop watch was started), the subject removed a 20-ft. straight aluminum ladder from the side of the pumper and transported it to the side of the two-story building. He then positioned the ladder and raised it. The subject then proceeded to climb to the roof with another person holding the base of the ladder. When the subject reached the roof of the building, another person helped load the subject, who was still standing on the ladder, with a duffle bag which was weighted to 150 lbs. The subject then proceeded to bring the weighted duffle bag down the ladder, using the walk-down technique. At the point when the subject's foot touched the ground, the instructor proceeded to stop the watch and recorded the elapsed time to accomplish the above task.

9. Improper and Dangerous Equipment Storage - Each firefighter was tested individually in the following manner:

No special dress was required. The scene was set as follows: There were two (2) 2-1/2 inch hoses which were rolled incorrectly (male end to the outside). Sandwiched in between these two (2) 2-1/2 inch

hoses was a 1-1/2 inch hose which was rolled correctly (female end to the outside). This pile of hoses was stored against the wall directly adjacent to the front end of a vehicle at the station. Also, a fire extinguisher was placed directly in the path of the individual and almost under the front wheel of the vehicle adjacent to the pile of hoses. The instructor then sent the subject out to pick up the 1-1/2 inch hose sandwiched in between the two (2) 2-1/2 inch hoses. A confederate was monitoring the test on the floor of the station house and noted whether or not the subject moved the fire extinguisher from the path of the vehicle. Upon the subject's return with the 1-1/2 inch hose to the instructor, the subject was asked if he noticed anything unusual during his assignment. The instructor recorded if the subject reported the fire extinguisher location and/or moved the fire extinguisher.

10. Hose and Nozzle (Equipment) Inspection - Each firefighter was tested individually in the following manner:

No special dress was required. Instructors selected the hoses to be inspected from among the following types: steamer hoses, 2-1/2 inch hoses, and 1-1/2 inch hoses. Instructors selected the nozzles to be inspected from among the following types: straight bore and fog nozzles. Hoses and nozzles (defective) were interspersed with good hoses and nozzles and the subject was asked to pick out the defective equipment. All hoses and nozzles were numbered and subjects reported the numbers of the defective equipment to the instructor. The score was determined by the number of defective pieces of equip-

ment detected. Hose defects included:

1) Set screws missing (steamer hose).

2) Couplings out-of-round (1-1/2 inch and 2-1/2 inch hoses).

3) Burred threads (1-1/2 inch and 2-1/2 inch hoses).

4) Gaskets missing (1-1/2 inch and 2-1/2 inch hoses).

5) Brazed sections (1-1/2 inch and 2-1/2 inch hoses).

6) Frozen male couplings (1-1/2 inch and 2-1/2 inch hoses).

Nozzle defects included:

1) Burred tip (straight).

2) Ball joint sticking (fog nozzle).

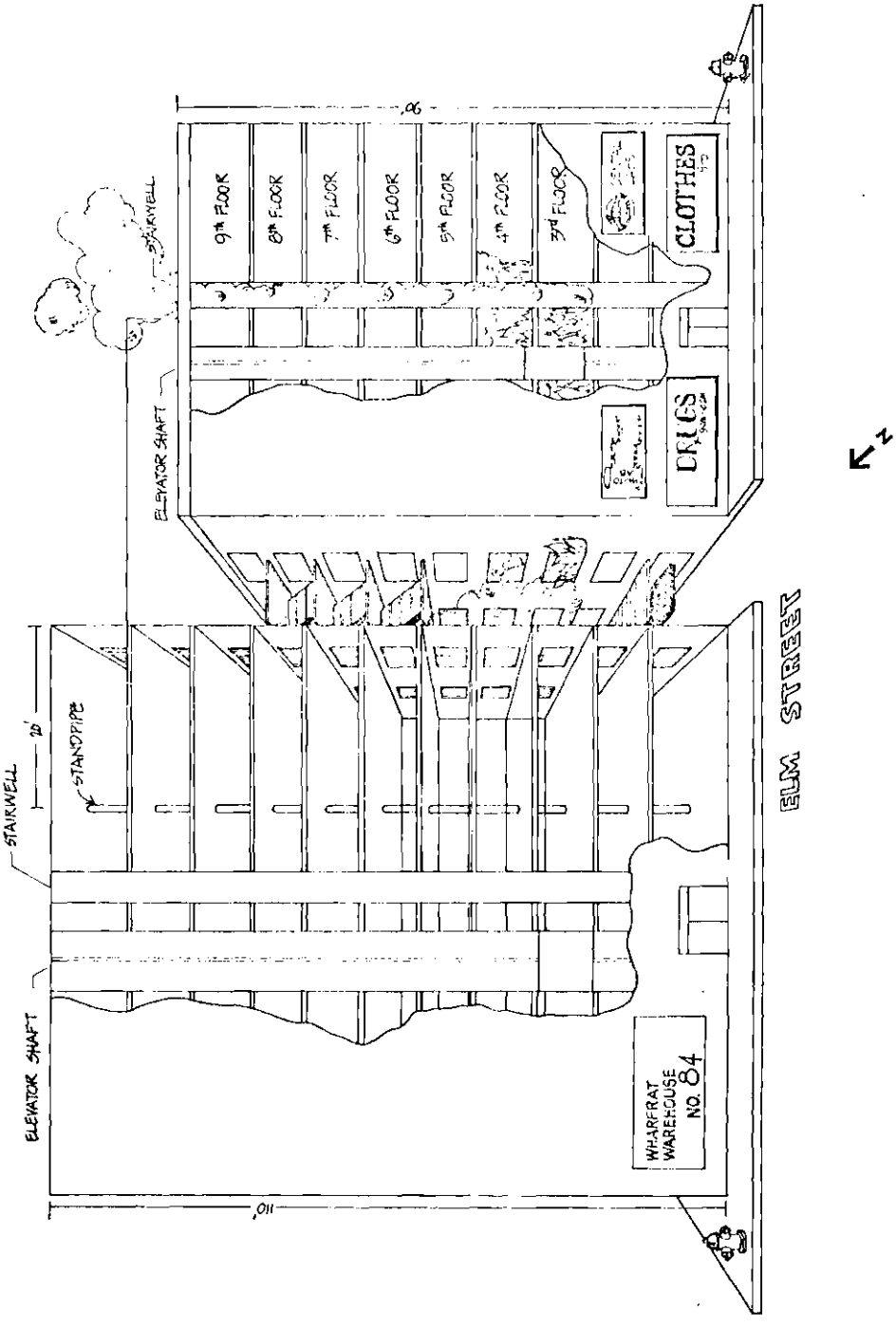
3) Gaskets missing (fog nozzles).

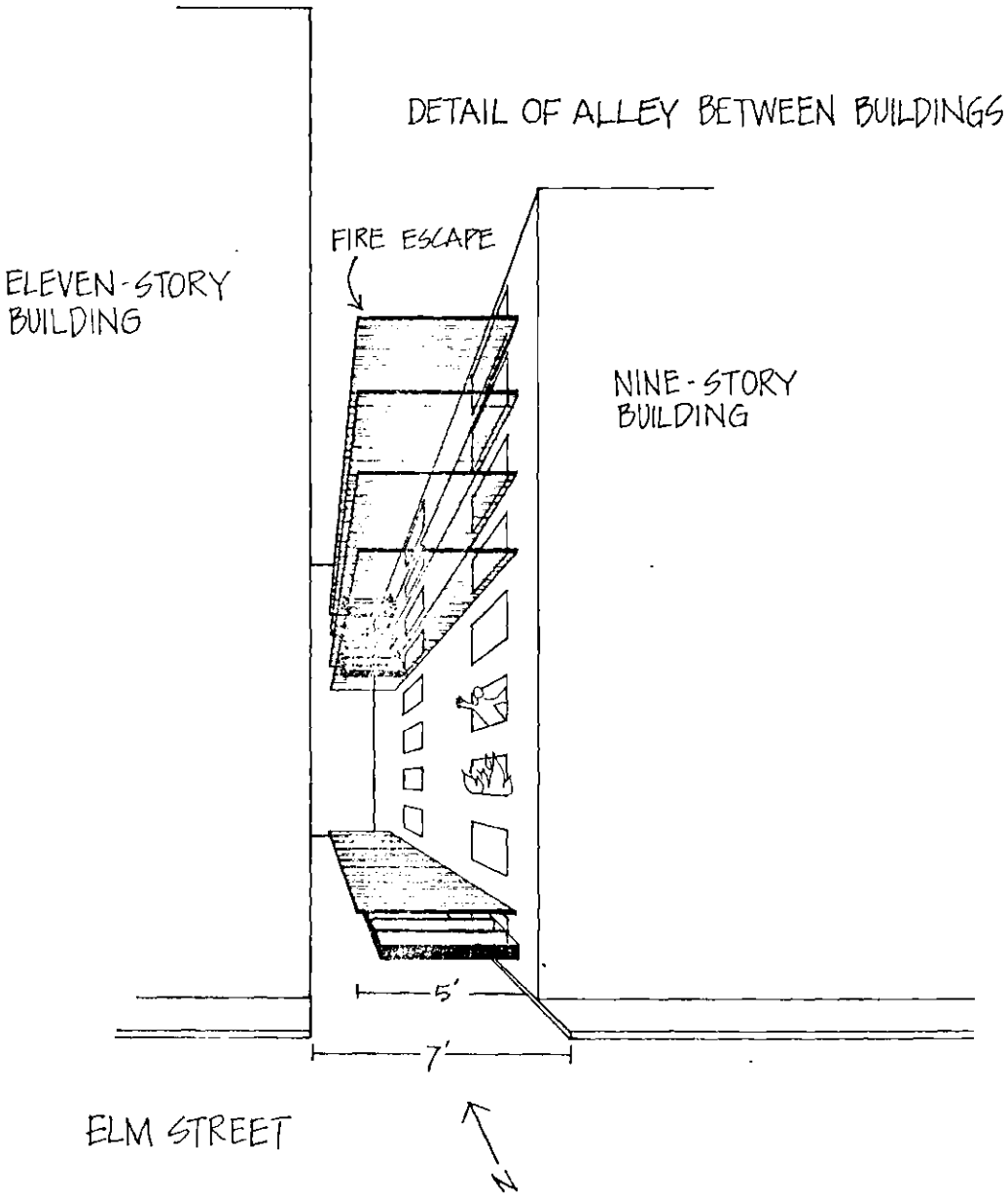
4) Set screws missing (fog nozzles).

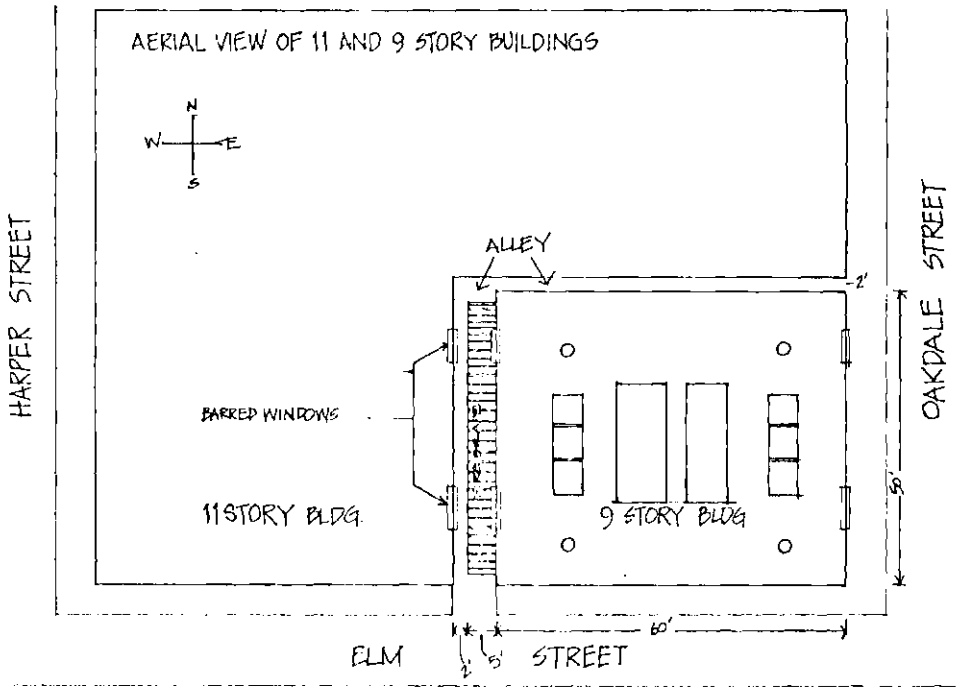
5) Baffles working freely (fog nozzles).

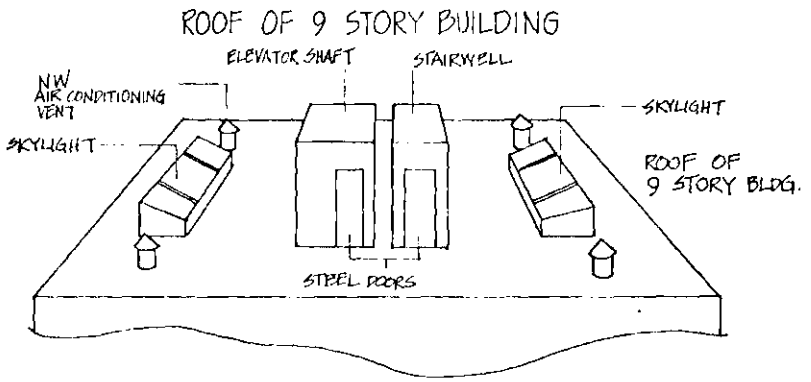
There was a total of ten (10) hoses used in the test, of which six (6) were defective and four (4) were acceptable. There was a total of six (6) nozzles used in the test, of which three (3) were defective and three (3) were acceptable.

APPENDIX VII




DETAIL OF ALLEY BETWEEN BUILDINGS
FIRE ESCAPE
ELEVEN-STORY BUILDING
NINE-STORY BUILDING
5'
7'
ELM STREET
N


AERIAL VIEW OF 11 AND 9 STORY BUILDINGS
N
W
E
S
HARPER STREET
ALLEY
2'
OAKDALE STREET
BARRED WINDOWS
11 STORY BLDG.
9 STORY BLDG.
50'
60'
ELM
STREET


ROOF OF 9 STORY BUILDING
ELEVATOR SHAFT
STAIRWELL
NW AIR CONDITIONING VENT
SKYLIGHT
SKYLIGHT
ROOF OF 9 STORY BLDG.
STEEL DOORS

HYPOTHETICAL FIRE SITUATION
NARRATIVE

Date: December 12

Time: 10:30 p.m. (2230 hrs.)

Temperature: 5° (Five degrees above zero)

Wind Velocity and Direction: 10 m.p.h. from the N.W.

Relative Humidity: 95%

Involved Building: Nine stories tall (60' x 50' x 90')

Adjacent Building: Eleven stories tall (height of 110')

Alley Between Buildings: Seven feet wide on west side of involved building and two feet wide on north side of involved building.

Fire Escape on West Side of Involved Building: The fire escape stretches out five feet into the seven foot alley from the west wall of the involved building.

Elevator in Involved Building: Is a hydraulic elevator located halfway between the third and fourth floor of the involved building.

Windows of Adjacent Building: Each window contains six 1/4-inch diameter iron rods installed in a vertical position.

The fire is located on the six hundred block of Elm Street between Harper and Oakdale Streets. The involved nine story building is located on the corner of Oakdale and Elm Street; it is under renovation and is only partially completed. The first two floors have been converted into commercial offices and stores. The upper floors are being remodeled into apartments of which only the third and fourth floors are currently occupied. These apartments are being rented to married couples between the ages of 35-to-55 who have no children. There are two windows on the east and west sides on each floor of the involved building. There are no windows in the front or the back of the involved building except on the first two floors.

There is a fire escape on the west side of the involved building, but a section of the fire escape from the third through the fifth is missing and is in the process of being replaced. There is no standpipe in the involved building, but the owners are in the process of collecting bids for its installation.

On the roof of the involved building are two penthouses, one of which is for the hydraulic elevator and the other is for the stairwell. Both of these penthouses are constructed of cinderblocks with heavy gauge metal doors which are always kept locked. The flat concrete roof of the involved building contains two skylights, one on the east side of the building and one on the west side of the building. There are also four air-conditioning ventilation hoods located on the roof. The northwest air-conditioning ventilation hood serves the first and second floors. The southwest air conditioning ventilation hood serves the third and fourth floors and the southeast and northeast air conditioning ventilation hoods serve the remaining five floors of the involved building.

There is a security guard on duty in the building 24 hours a day to check people in and out of the building after 6 p.m. He reports that there are 13 people in the building at the time of the fire. All 13 people are uninjured and are huddled at the fourth floor window on the west side of the involved building. The fire itself is on the third floor and the west side of the third floor is totally involved. The fire doors on the third and fourth floors were propped open so that the fire has spread to the third and fourth floor stairwells and has cut off evacuation of the trapped victims through the windows on the east end of the fourth floor. The elevator itself is not yet involved but is surrounded by fire.

The involved building is enclosed on the west and north sides by an adjacent L-shaped eleven story warehouse. For protection of the warehouse contents, there are six 1/4-inch diameter iron bars installed vertically in every window of the warehouse. Also there is a standpipe installed twenty feet from the east wall adjacent to the involved building. The first three floors of the warehouse are used for the storage of furniture, the next four floors contain furs and the top four floors contain shoes. There are two security guards on duty around the clock at the warehouse. There is also a heavy equipment elevator as well as a stairwell located some fifty feet from the east wall adjacent to the involved building.

FIREFIGHTER RESCUE KNOWLEDGE

You and three other men have been ordered to rescue 13 victims trapped on the fourth floor of the involved nine story building. By referring to the descriptive narrative and the set of drawings of the fire scene which are provided, you are asked to determine from a set of alternatives:

1) The proper rescue technique;
2) The proper method of providing protection from exposure to the victims being rescued;
3) The minimum amount of equipment necessary to accomplish the rescue.

FIREFIGHTER VENTILATION KNOWLEDGE

You and one other man have been ordered to ventilate the nine story involved building following completion of rescue operations. By referring to the descriptive narrative and the set of drawings of the fire scene which are provided, you are asked to:

1) Determine the proper access to the roof of the involved building;
2) Determine the proper order of ventilation;
3) Describe the methods to accomplish the necessary ventilation;
4) Determine the minimum amount of equipment necessary to accomplish the required ventilation from among a listing of equipment available.

FIREFIGHTER FIRE SUPPRESSION KNOWLEDGE

Two pumpers have arrived at the fire scene and one was spotted at the west end of the block and the other was spotted at the east end of the block. Fire hydrants at each of these two locations have been caught with two (2) 2-1/2 inch supply lines and in turn these supply lines are furnishing water to the pumpers.

Two (2) 2-1/2 inch attack lines were then pulled from the pumper at the west end of the block and were then attached and charged to the standpipe in the adjacent building. Attached to the standpipe system in the adjacent building are the following attack lines:

1. On the ninth floor, one (1) 100 foot section of 2-1/2 inch hose laid and charged to the roof of the involved building.

2. On the fourth floor, one (1) 50 foot section of 1-1/2 inch hose laid and charged to the fourth floor window of the adjacent building.

3. On the third floor, one (1) 50 foot section of 1-1/2 inch hose laid and charged to the third floor window of the adjacent building.

In addition to the two (2) attack lines attached to the standpipe system of the adjacent building, there is a third 2-1/2 inch attack line which has been laid and charged from the pumper which is spotted at the west end of the block to the alley between the two buildings. Two (2) 2-1/2 inch attack lines have also been laid and charged from the pumper positioned at the east end of the block to the second floor landing of the involved building.

By referring to the descriptive narrative, the set of drawings of the fire scene, and the above information as to types and locations of attack lines which are availabe at the fire scene, you are asked to determine which statements about actions to be taken are correct. The statements will deal with what to do and when to do it.

FIREFIGHTER SALVAGE AND OVERHAUL KNOWLEDGE

When you arrive to begin salvage operations, there are approximately three inches of water standing in the third floor of the involved building. A leak has allowed two inches of water to drain into the photo lab on the second floor. There is only one leak coming from the third floor and that is in the center of the second floor ceiling. Following extinguishment, overhaul operations are begun.

You have been ordered to conduct salvage and overhaul operations in the involved nine story building. By referring to the descriptive narrative, the set of drawings of the fire scene, and the above information, you are asked to determine which statements about actions to be taken are correct. The statements will deal with what should be done and what should not be done during salvage and overhaul operations in the involved nine story building.

POSSIBLE RESCUE TECHNIQUES

(Find one yes item)

1. Hotel raise of 35 ft. ladder in the alley to the 4th floor of the involved building. 1. ☐
2. Factory raise of 35 ft. ladder in the alley to the 4th floor of the involved building. 2. ☐
3. Narrow alley raise of 35 ft. ladder in the alley to the 4th floor of the involved building. 3. ☐
4. Climb the fire escape to the second floor landing of the involved building and then raise a 14 ft. ladder from the second floor landing to the 4th floor of the involved building. 4. ☐
5. Climb the stairwell of the adjacent building to the ninth floor and then bridge across to the roof of the involved building and proceed to the 4th floor. 5. ☐
6. Ride the elevator of the adjacent building to the seventh floor and bridge across to the seventh floor of the involved building and proceed to the fourth floor. 6. ☐
7. Climb the stairwell of the adjacent building to the sixth floor and bridge across to the fifth floor of the involved building and proceed to the fourth floor. 7. ☐
8. Ride the elevator of the adjacent building to the fourth floor and bridge across to the fifth floor of the involved building and proceed to the fourth floor. 8. ☐
9. Climb the stairwell of the adjacent building to the fourth floor and bridge across to the fourth floor of the involved building. 9. ☐
10. Ride the elevator of the adjacent building to the third floor and bridge across to the third floor of the involved building and proceed to the fourth floor. 10. ☐
11. Evacuate the victims down the elevator of the involved building. 11. ☐
12. Evacuate the victims down the stairwell of the involved building. 12. ☐

POSSIBLE METHODS OF PROVIDING PROTECTION FROM EXPOSURE TO VICTIMS BEING RESCUED

(Find One Yes Item)

1. Climb the fire escape to the second floor landing of the involved building and then proceed to direct a fog stream pattern up to the third floor window of the involved building. 1.

2. Direct a fog stream pattern from the ground to a point just above the third floor window of the involved building. 2.

3. Ride the elevator of the adjacent building to the fourth floor and then proceed to direct a straight stream pattern to a point just above the third floor window of the involved building. 3.

4. Climb the stairwell of the adjacent building to the third floor and then proceed to direct a fog stream pattern to a point just below the third floor window of the involved building. 4.

5. Ride the elevator of the adjacent building to the third floor and then proceed to direct a straight stream pattern into the third floor window of the involved building. 5.

6. Direct a straight stream pattern from the ground to a point just above the third floor window of the involved building. 6.

7. Climb the stairwell of the adjacent building to the fourth floor and then proceed to direct a fog stream pattern to a point just above the third floor window of the involved building. 7.

8. Ride the elevator of the adjacent building to the fifth floor and proceed to direct a straight stream pattern into the third floor window of the involved building. 8.

9. Climb the stairwell of the adjacent building to the fifth floor and then proceed to direct a straight stream pattern to a point just above the third floor window of the involved building. 9.

10. Ride the elevator of the adjacent building to the second floor and then proceed to direct a straight stream pattern to a point just above the third floor window of the involved building. 10.

11. Climb the stairwell of the adjacent building to the second floor and then proceed to direct a fog stream pattern to a point just above the third floor window of the involved building. 11.

12. Ride the elevator of the involved building to the third floor and proceed to direct a straight stream pattern into the involved third floor room. 12.

13. Climb the stairwell of the involved building to the third floor and proceed to direct a fog stream pattern into the involved third floor room. 13.

EQUIPMENT NECESSARY FOR RESCUE
(Find Ten Yes Items)

1.	50 ft. of 1½-inch hose	1.
2.	Disaster pouches	2.
3.	Scott Air paks (For victims)	3.
4.	Sledge hammer	4.
5.	Rubber mallet	5.
6.	Fog nozzle (1½-inch)	6.
7.	Chisel	7.
8.	Crow bar	8.
9.	Spanner wrench	9.
10.	Portable generator	10.
11.	Straight bore nozzle (2½-inch)	11.
12.	Shovel	12.
13.	14 ft. roof ladder	13.
14.	10 ft. folding ladder	14.
15.	Life net	15.
16.	50 ft. wooden extension ladder with tormentor poles	16.
17.	1½ x 2½-inch adapter	17.
18.	50 ft. aluminum extension ladder with tormentor poles	18.
19.	Cellar nozzle	19.
20.	150 ft. of 2½-inch hose	20.
21.	Rescue saw	21.
22.	Wire cutters	22.
23.	Porta-power	23.
24.	Wood mallet	24.
25.	Two (2) 100 ft. sections of 3/4-inch manila hemp rope	25.
26.	Stokes basket	26.
27.	Resuscitator	27.
28.	Straight bore nozzle (1½-inch)	28.
29.	Portable radio	29.
30.	35 ft. aluminum extension ladder with tormentor poles	30.
31.	35 ft. wooden extension ladder with tormentor poles	31.
32.	Master stream appliance	32.
33.	Pick head axe	33.
34.	Scott Air paks (Personal)	34.
35.	Blankets	35.
36.	Signal flares	36.
37.	Fog nozzle (2½-inch)	37.
38.	Flashlight	38.
39.	Straight jacket	39.

POSSIBLE METHODS OF ACCESS
(Find Three Yes Items)

1. Climb the stairwell of the involved building to the roof of the involved building. 1. ☐
2. Ride the elevator of the involved building to the roof of the involved building. 2. ☐
3. Climb the fire escape of the involved building to the roof of the involved building. 3. ☐
4. Climb the stairwell of the adjacent building to the ninth floor and then proceed to bridge across to the roof of the involved building. 4. ☐
5. Ride the elevator of the adjacent building to the fourth floor and then bridge across to the fourth floor of the involved building. From this point proceed up the stairwell of the involved building to the roof of the involved building. 5. ☐
6. Climb the stairwell of the adjacent building to the fifth floor and then bridge across to the fifth floor of the involved building. From this point proceed up the stairwell of the involved building to the roof of the involved building. 6. ☐
7. Spot an aerial ladder truck at the front of the involved building. Fully extend the ladder (75 ft.) to the roof of the involved building and then proceed to climb to the roof of the involved building. 7. ☐
8. Place an aerial ladder truck on the East side of the involved building and set the 75 ft. ladder into the sixth floor window of the involved building. Then climb the ladder to the sixth floor of the involved building and make your way across the sixth floor to the fire escape and then climb to the roof of the involved building. 8. ☐
9. Climb the stairwell of the adjacent building to the third floor and bridge across to the third floor window of the involved building. From this point proceed up the stairwell of the involved building to the roof of the involved building. 9. ☐
10. Spot an aerial ladder truck at the front of the adjacent building. Fully extend the ladder (75 ft.) to the roof of the adjacent building and then proceed to climb to the roof of the adjacent building. Next, climb down the stairwell of the adjacent building to the proper floor and then bridge across to the roof of the involved building. 10. ☐
11. Place an aerial ladder truck on the East side of the involved building and set the 75 ft. ladder into the fifth floor window of the involved building. Then climb the ladder to the fifth floor of the involved building and make your way across the fifth floor to the fire escape and then climb it to the roof of the involved building. 11. ☐
12. Climb the stairwell of the adjacent building to the sixth floor and proceed to bridge across to the fire escape on the sixth floor of the involved building and then proceed to climb to the roof of the involved building. 12. ☐
13. Spot an aerial ladder truck at the back of the involved building. Fully extend the ladder (75 ft.) to the roof of the involved building and then proceed to climb to the roof of the involved building. 13. ☐

ORDER OF VENTILATION

Determine the proper sequence of four of these items in order of importance and effectiveness, and number them accordingly (such as, "1" would indicate that the item should be handled first):

_____ West Skylight

_____ Northwest Air Conditioning Vent

_____ Elevator Penthouse

_____ Southwest Air Conditioning Vent

_____ Stairwell Penthouse

_____ Northeast Air Conditioning Vent

_____ East Skylight

_____ Southeast Air Conditioning Vent

_____ Cut 6 ft. x 6 ft. Hole in Roof

METHODS OF VENTILATION

Explain in a short narrative paragraph how you would accomplish the venting of each item:

1. Stairwell Penthouse

2. Elevator Penthouse

3. Northwest Air Conditioning Vent

4. Southwest Air Conditioning Vent

EQUIPMENT NECESSARY FOR VENTILATION
(Find Four Yes Items)

1.	150 ft. of 1½-inch hose	1.
2.	Fog nozzle (1½-inch)	2.
3.	Straight bore nozzle (1½-inch)	3.
4.	Straight bore nozzle (2½-inch)	4.
5.	Spanner wrench	5.
6.	1½ x 2½-inch adapter	6.
7.	Rescue saw	7.
8.	Two (2) 100 ft. sections of 3/4 inch manila hemp rope	8.
9.	Emergency lighting	9.
10.	Portable radio	10.
11.	Blankets	11.
12.	Resuscitator	12.
13.	Stokes basket	13.
14.	Acetylene torch	14.
15.	Pick head axe	15.
16.	Wood mallet	16.
17.	Rubber mallet	17.
18.	Chisel	18.
19.	Crow bar	19.
20.	Sledge hammer	20.
21.	Scott Air paks (For victims)	21.
22.	Portable generator	22.
23.	Disaster pouches	23.
24.	Scott Air paks (Personal)	24.
25.	Porta-power	25.
26.	50 ft. wooden extension ladder with tormentor poles	26.
27.	Cellar nozzle	27.
28.	Wire cutters	28.
29.	Straight jacket	29.
30.	10 ft. folding ladder	30.
31.	Master stream appliance	31.
32.	Life net	32.
33.	50 ft. aluminum extension ladder with tormentor poles	33.
34.	Flashlight	34.
35.	35 ft. aluminum extension ladder with tormentor poles	35.
36.	35 ft. wooden extension ladder with tormentor poles	36.
37.	Signal flares	37.
38.	Shovel	38.

APPENDIX X

POSSIBLE METHODS OF FIRE SUPPRESSION
(Find Three Yes Items)

1. After the victims have been rescued from the fourth floor of the involved building and ventilation has been completed on the roof of the involved building, there is no need to continue exposure protection from the fourth floor of the adjacent building by directing a fog stream pattern to a point just above the third floor window of the involved building. 1.

2. After the victims have been rescued from the fourth floor of the involved building, a fog stream pattern should be directed from the fourth floor window of the adjacent building across the alley and into the fourth floor window of the involved building in order to prevent an upward extension of the fire from the third floor of the involved building. 2.

3. A straight stream pattern should be directed from the third floor window of the adjacent building and into the second floor window of the involved building in order to prevent a downward extension of the fire from the third floor of the involved building. 3.

4. The Firefighters in the involved stairwell should be flowing water onto the third floor stairwell even before ventilation is completed in order to prevent a downward extension of the fire from the third floor landing. 4.

5. The Firefighters in the involved stairwell should try to gain access to the involved third floor stairwell landing only after ventilation of the stairwell is completed. 5.

6. The Firefighters on the fourth floor of the adjacent building should bridge across to the fourth floor of the involved building and then proceed to chop a hole in the floor. After the opening in the third floor ceiling is of sufficient size, they should install a cellar nozzle and attach their 50 ft. section of 1½-inch hose to it and then they should proceed to pour the water into the involved third floor room. 6.

7. The Firefighters in the alley between the two buildings should be playing a straight stream pattern from their 2½-inch hose line onto the second and fourth floors of both buildings in order to prevent the fire from spreading to the adjacent building from the third floor of the involved building. 7.

8. A straight stream pattern should be directed from the third floor window of the adjacent building into the third floor window of the involved building before completion of rescue and ventilation operations. 8.

9. The Firefighters in the involved stairwell should gain access to the third floor stairwell landing and then should proceed to attack the base of the fire using a straight stream pattern from their 2½-inch attack lines before the completion of rescue operations and prior to the completion of ventilation on the roof of the involved building. 9.

10. A fog stream pattern should be directed from the third floor window of the adjacent building into the third floor window of the involved building prior to completion of rescue and ventilation operations. 10.

11. After ventilation operations are completed, the firefighters on the roof of the involved building should proceed down the stairwell of the involved building with their 2½-inch attack line to attack the fire on the third floor landing from above. 11.

12. After ventilation operations are completed, the Firefighters on the roof of the involved building should proceed to direct a fog stream from their 2½-inch attack line on the smoke, superheated gases, and burning debris which are being exhausted from the ventilation ports which have been opened in order to prevent the fire from spreading onto the roof of the involved building and/or the adjacent building. 12.

13. After ventilation has been completed, the Firefighters, in the alley between the two buildings, should proceed to climb, with their 2½-inch attack lines, the fire escape of the involved building to the third floor window and then proceed to enter the window using a fog stream pattern to locate and attack the base of the fire in the involved third floor room. 13.

14. Upon completion of rescue and ventilation operations, the firefighters in the involved stairwell should be ready to immediately enter the involved third floor room using a fog stream pattern from their 2½-inch attack lines to locate and attack the base of the fire. 14.

APPENDIX XI

POSSIBLE SALVAGE AND OVERHAUL TECHNIQUES
(Find Four Yes Items)

1.	Upon return to the fire station any salvage covers which have been used during this operation should be spread directly in the sun to dry, thus decreasing the amount of time required for them to dry and the amount of time they are out of service.	1.
2.	During salvage operations in the photo lab, a shelf containing many empty glass beakers falls from the wall and covers the floor with glass. Therefore, a salvage cover should be placed over this broken glass to protect the firefighters who will be working in the room.	2.
3.	In order to remove the water which is standing in the floor of the photo lab, a water chute should be constructed from the photo lab to the third floor stairwell landing and the water should be channeled from this point down the stairwell.	3.
4.	A possible method of preventing more water from accumulating in the photo lab is to construct a water chute running from the points where water is leaking in from the third floor such that the water is channeled out the second floor window and into the alley.	4.
5.	There is no need to remove water from the photo lab during fire fighting operations for it could not possibly cause a problem.	5.
6.	In order to remove the water which is standing in the floor of the photo lab, a toilet bowl could be removed in the photo lab and a strainer placed over the drain pipe which is exposed.	6.
7.	The Firefighters in the photo lab could install several scuppers at the floor level in the lab and extend them through the exterior walls as a method of draining water from the second floor.	7.
8.	The only thing a firefighter would have to do to remove the water standing in the photo lab would be to drill a hole in the floor with an auger near the west windows and then allow the water to drain out.	8.
9.	A portable pump could be set up in the photo lab in order to remove the water which is standing there.	9.
10.	During overhaul operations it is not important to preserve any evidence of arson found on the third floor of the involved building, for this information can be found later by the fire inspector who conducts the investigation to determine the cause of the fire.	10.
11.	During overhaul operations it is not the responsibility of the firefighter to check all utility services for leaks in gas mains and water mains or electric lines for shorts since the utilities will probably not be turned back on for several days following the fire anyway.	11.
12.	During overhaul operations, any smoldering debris which is found on the fourth floor of the involved building can quickly be extinguished with a blast of water from any available 2½-inch attack line.	12.
13.	Following completion of overhaul operations in the involved building, either a responsible person or the police department should be called to assume responsibility for the building before the fire department leaves the scene.	13.
14.	If persistent smoldering is noticed coming from a wall on the third floor of the involved building during overhaul operations, the firefighter should not knock a hole in the wall to investigate because he would be needlessly destroying personal property.	14.
15.	Overhaul operations should be started in the photo lab on the second floor and when this is completed, the overhaul operation should be started on the third floor of the involved building. Always work to clean up from the bottom to the top.	15.
16.	It is found during overhaul operations that a shelf has fallen into the floor in the drug store storage room of the involved building. There are at least six or seven different dry chemical compounds which have been mixed as a result of the shelf having fallen. There is a water drain in the middle of the small storage room floor, therefore the firefighter should proceed to wash these chemicals down the drain using a small water hose.	16.
17.	During overhaul the firefighters should never waste time checking the air conditioning ventilation ducts on the third floor of the involved building following extinguishment of the fire on the third floor.	17.
18.	The involved nine-story building should not be ventilated (open windows and doors) before overhaul operations are to begin following extinguishment of the fire.	18.
19.	Any acid which has been spilled in the photo lab should be washed down a floor drain using a small water hose.	19.
20.	The moveable expensive equipment in the photo processing lab should be grouped into as small an area as possible on the second floor of the involved building and should then be covered with a salvage cover.	20.

APPENDIX XII

SYMPTOMS

A fire alarm is received at Station 1 and a pumper is called on the alarm. Upon arrival at the scene it is found that the involved building is located at the end of a dead end street. The pumper is positioned (spotted correctly). Then a 4½-inch streamer supply line is hooked from the hydrant to the pumper and a gate valve is attached to one of the 2½-inch hydrant outlets. The hydrant is then turned on and water is coming to the pumper. The pumper operator has a static pressure reading of 80 lbs. on the compound pressure gauge. The officer calls for one (1) 1½ in. section of 2½-inch hose line to be laid to the side of the building and then charged. This line is put into operation and the pumper operator notes a 15 pound drop (165) on the compound pressure gauge. The officer then requests two identical lines (same footage and diameter, to be dropped and put into operation. From the previous compound pressure gauge reading, the pumper operator notes that he can add these additional lines and does so. He notes that the compound pressure gauge has dropped to 10 pounds, which is in a safe operating range. For a period of two minutes, the operation is running smoothly. Then suddenly he notes a fluctuation in the engine rpm.
Note: A single-stage centrifugal pumper is being used. The pumper operator is not in communication with his officer or with other firefighters at the time of the problem.

CHECK

(Find Four Ten Items)

1.	Check intake strainer	1.
2.	Check impeller of pump	2.
3.	Tachometer (Rev./minute of engine)	3.
4.	Prime of the pump	4.
5.	Intake cap seal	5.
6.	Discharge Pressure gauge	6.
7.	Pump circulator valve	7.
8.	Supply line from hydrant	8.
9.	Change over valve	9.
10.	Hydrant	10.
11.	Compound Pressure Gauge	11.
12.	Radiator fill Valve	12.
13.	Auxiliary Cooling valve	13.
14.	Oil Pressure Gauge	14.
15.	Booster Tank fill Gauge	15.
16.	Engine Temperature Gauge	16.
17.	Pump in Proper gear	17.

ACTIONS TO TAKE

(Find Three Ten Items)

1.	Tee in additional 2½-inch supply line from 2½-inch gate valve to pumper	1.
2.	Shut down one 2½-inch attack line	2.
3.	Refill booster tank	3.
4.	Increase engine RPM	4.
5.	Decrease engine RPM	5.
6.	Prime the pump	6.
7.	Shut down two 2½-inch attack lines	7.
8.	Cle k booster tank outlet	8.
9.	Gate down intake supply line	9.
10.	Gate down supply line from hydrant	10.
11.	Gate down all three 2½-inch discharge lines	11.
12.	Close pump circulator valve	12.
13.	Shut down all three 2½-inch attack lines	13.
14.	Gate down two 2½-inch discharge lines	14.
15.	Gate down o e 2½-inch discharge line	15.
16.	Tie in additional 2½-inch supply line from another hydrant	16.
17.	Change position of change over valve from pressure to volume	17.
18.	Open hydrant further	18.
19.	Clean impeller of pump	19.
20.	Clean intake strainer	20.

THE IS JUST CAUSES WHY

(Find Three Ten Items)

1.	Empty booster tank pump	1.
2.	Strainer too close to surface	2.
3.	Pump has lost its prime	3.
4.	Demand is more than water main can supply	4.
5.	Strainer lifted out of water	5.
6.	Sheared pump gear	6.
7.	Seal broken on intake caps	7.
8.	Partially clogged pump intake strainer	8.
9.	Operation of washing machines in this area	9.
10.	Strainer too close to bottom	10.
11.	Pump has jumped out of gear	11.
12.	The impeller is partially clogged	12.
13.	Toilet flushes in area	13.
14.	Collapsed hard-suction hose	14.

EMERGENCY AIR PAK TAB TEST

SYMPTOMS

A new recruit has been checked out on the recharging and servicing of the MSA air pak. The four (4) MSA air paks on pumper No. 2 are approximately two years old, so early this morning the recruit was told to replace the old diaphrams with new diaphrams, then recharge the empty compressed air tanks and then put them back into service on pumper No. 2. This was accomplished. Later this same afternoon, an alarm is received and pumper No. 2 is rolled. Upon arrival at the fire scene, two of the four firefighters find that their MSA air paks are not delivering enough air on demand.

CHECK

(Find One Yes Item)

1. Regulator gauge	1.
2. Tank valve	2.
3. Head harness	3.
4. Chest strap	4.
5. Speaking diaphram	5.
6. Tank gauge	6.
7. High pressure hose	7.
8. Low pressure hose	8.
9. Face piece	9.
10. Lens	10.
11. Diaphram assembly	11.
12. Regulator mainline knob	12.
13. Regulator b,-pass knob	13.
14. Waist strap	14.

ACTION TO TAKE

(Find One Yes Item)

1. Close tank valve	1.
2. Loosen head harness	2.
3. Tighten chest strap	3.
4. Free exhalation valve	4.
5. Tighten speaking diaphram	5.
6. Loosen face piece	6.
7. Tighten high pressure hose	7.
8. Loosen low pressure hose	8.
9. Adjsut face piece	9.
10. Wipe lens clean	10.
11. Rearrange diaphram admission valve levers	11.
12. Close regulator main line knob	12.
13. Open regulator by-pass knob	13.
14. Tighten waist strap	14.
15. Loosen exhalation valve	15.

POSSIBLE CAUSE

(Find One Yes Item)

1. Empty compressed air tank	1.
2. Main line regulator is closed	2.
3. Diaphiam is split	3.
4. Exhalation valve is stuck	4.
5. Improper arrangement of admission valve levers	5.
6. Leak in high pressure hose	6.
7. Regulator by-pass is closed	7.
8. Speaking diaphram is split	8.
9. Kinked low pressure hose	9.
10. Tank valve is closed	10.

APPENDIX XIII

GEORGIA HEART ASSOCIATION, INC.
Broadview Plaza, Level C
2581 Piedmont Road, N.E.
Atlanta, Georgia 30324

Jurisdiction _____ (Score)

WRITTEN EXAMINATION FOR CARDIOPULMONARY RESUSCITATION

(Print Name)

		CORRECT POINTS
1. What EMERGENCY MEASURES of CPR do you apply if the victim (a) Is unconscious (b) Is not breathing (c) Has no pulse (counts 3)	(a) (b) (c)	
2. Irreversible damage to the brain's higher centers after the heart has stopped will begin to occur in *most* persons in approximately what length of time? (counts 1)		
3. In ordinary fainting, a person will have a regular pulse (though it may be weak), accompanied by shallow breathing and will not have fixed dilated pupils (counts 2)	True False	
4. About two minutes after the blood has stopped going to the brain, the pupils of the eyes become. (a) Very small, approaching pinpoint size (b) Normal in size, but losing their usual shape (c) Greatly enlarged in size (counts 1)	(Circle correct letter) (a) (b) (c)	
5. In which two areas is the rescuer most likely to detect a pulse? (counts 2)	(1) (2)	
6. In an auto accident a victim is found to have a pulse but no breathing, with blood coming from the mouth. Should mouth to nose respiration be attempted? (counts 1)	Yes No	
7. A man falls down while mowing his lawn and is unconscious. In determining the difference between a possible cardiac arrest and other causes of this event, such as fainting, the rescuer should look for three things (counts 3)	(1) (2) (3)	
8. After 30 minutes of cardiopulmonary resuscitation, a victim's *pupils are contracted*, but he is neither breathing or producing a pulse by himself. Rescue attempts may be stopped because the patient's own heart beat cannot be restored after this length of time (counts 1)	True False	
9. Should external cardiac compression be stopped and ventilation discontinued while the patient is being moved or driven to the hospital? (counts 1)	Yes No	

10. The victim is lying face down in the grass; the rescuer should attempt to place him so that (a) He is on his belly, one hand placed under his head, which is placed facing sideward. (b) The patient is placed on his back, the head raised forward and upward. (c) The patient is placed on his back, the neck raised and the head tilted back. (counts 1)	(Circle correct letter) (a) (b) (c)
11. In a person who has drowned, one should not begin mouth-to-mouth respiration until *ALL* the water has been drained or suctioned from the lungs. (counts 1)	True False
12. The rescuer performing external compression should position himself (counts 1) (a) At the head of the victim (b) At one side of the victim (c) Straddle the victim	(Circle correct letter) (a) (b) (c)
13. In compressing the chest, the heel of the hand only should be placed (counts 1) (a) Upper half of sternum (b) Middle of sternum (c) Lower half of sternum	(Circle correct letter) (a) (b) (c)
14. In an adult, what is the ratio of ventilations to chest compressions with (counts 2)	One operator: Two operators:
15. The rescuer determines that the victim is unconscious and not breathing. Immediate action is indicated. Number the following steps in their proper sequence of performance: (counts 4) 1. Open airway by raising neck & tilting head backward 2. Start Cardiac Compression 3. Breathe into the victim's mouth or nose 3-4 times 4. Feel for the carotid pulse	Number _____ _____ _____ _____
16. (a) If a drowning victim has a pulse, no breathing is observed, and his pupils are enlarged, should external cardiac compression be given? (b) Should mouth-to-mouth respiration be given? (counts 2)	Yes No Yes No
TOTAL POINTS	

POINTS	SCORE
27	Excellent
23-26	Good
21-22	Fair
0-20	Need Review

Exam from American Heart Association Instructor's Manual. Revised 11/7/72 by Cardiopulmonary Resuscitation Committee of the Georgia Heart Association, Inc.

wes/jw/eb

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